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CONTENTS OF VOLUME 1.

(This volume is bound in three parts.)

1. Report of the Auditor General for the year ended March 31, 1913. VolumeI, Parts A to J, and Volume II, Parts K to U. Presented by Hon. Mr. Foster, January 28, 1914.
Printed for distribution and sessional papers.

1. Report of the Auditor General for the year ended March 31, 1913, Volume III, Parts V to Y. Presented by Hon. Mr. White, January 19, 1914.
Printed for distribution and sessional papers.

CONTENTS OF VOLUME 2.

2. The Public Accounts of Canada, for the fiscal year ended March 31, 1913. Presented by Hon. Mr. White, January 19, 1914.....*Printed for distribution and sessional papers.*

3. Estimates of sums required for the service of the Dominion for the year ending March 31, 1915. Presented by Hon. Mr. White, January 29, 1914.
Printed for distribution and sessional papers.

3a. Supplementary Estimates of sums required for the service of the Dominion for the year ending March 31, 1914. Presented by Hon. Mr. White, March 20, 1914.
Printed for distribution and sessional papers.

4. Supplementary Estimates of sums required for the service of the Dominion for the year ending March 31, 1915. Presented by Hon. Mr. White, May 28, 1914.
Printed for distribution and sessional papers.

5. Further Supplementary Estimates of sums required for the service of the Dominion for the year ending March 31, 1915. Presented by Hon. Mr. White, June 9, 1914.
Printed for distribution and sessional papers.

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6. List of Shareholders in the Chartered Banks of the Dominion of Canada as on December 31, 1913. Presented by Hon. Mr. White, January 19, 1914.
Printed for distribution and sessional papers.

CONTENTS OF VOLUME 4.

7. Report on dividends remaining unpaid, unclaimed balances and unpaid drafts and bills of exchange in Chartered Banks of the Dominion of Canada, for five years and upwards prior to December 31, 1913. Presented by Hon. Mr. White, March 16, 1914.
Printed for distribution and sessional papers.

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(This volume is bound in two parts.)

8. Report of Superintendent of Insurance for year ended 1913. Presented by Hon. Mr. White, June 2, 1914.
Printed for distribution and sessional papers.

9. Abstract of Statement of Insurance Companies in Canada for the year ended December 31, 1913. Presented by Hon. Mr. White, June 2, 1914.
Printed for distribution and sessional papers.

CONTENTS OF VOLUME 6.

10. Report of the Department of Trade and Commerce for the fiscal year ended March 31, 1913, Part I.—Canadian Trade. Presented by Hon. Mr. Foster, April 15, 1914.
Printed for distribution and sessional papers.

10*a*. Report of the Department of Trade and Commerce, for the year ended March 31, 1913: Part II.—Canadian Trade with (1) France, (2) Germany, (3) United Kingdom, and (4) United States. Presented by Hon. Mr. Foster, January 22, 1914.
Printed for distribution and sessional papers.

CONTENTS OF VOLUME 7.

10*b*. Report of the Department of Trade and Commerce for the fiscal year ended March 31, 1913: Part III.—Canadian Trade with Foreign Countries (except France, Germany, the United Kingdom and United States). Presented by Hon. Mr. Foster, April 15, 1914.
Printed for distribution and sessional papers.

10*c*. Report of the Department of Trade and Commerce, for the fiscal year ended March 31, 1913: Part IV.—Miscellaneous Information. Presented by Hon. Mr. Foster, April 27, 1914 .....*Printed for distribution and sessional papers.*

10*d*. Report of the Board of Grain Commissioners for Canada. Presented by Hon. Mr. Foster, June 4, 1914.....*Printed for distribution and sessional papers.*

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10*e*. Report of the Department of Trade and Commerce, for the fiscal year ending March 31, 1913: Part VI.—Subsidized Steamship Services, with Statistics showing Steamship Traffic to December 31, 1913, and Estimates for fiscal year 1914-1915. Presented by Hon. Mr. Foster, March 25, 1914.....*Printed for distribution and sessional papers.*

10*f*. Report of Trade and Commerce for fiscal year ended March 31, 1913: Part VII.—Trade of Foreign Countries, Treaties and Conventions. Presented by Hon. Mr. Foster, 1914.
Printed for distribution and sessional papers.

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11. Report of the Department of Customs for the year ended March 31, 1913. Presented by Hon. Mr. Reid, January 22, 1914.....*Printed for distribution and sessional papers.*

CONTENTS OF VOLUME 10.

12. Reports, Returns and Statistics of the Inland Revenues for the Dominion of Canada, for the year ended March 31, 1913. Part I.—Excise. Presented by Hon. Mr. Nantel, January 19, 1914.....*Printed for distribution and sessional papers.*

13. Part II.—Inspection of Weights and Measures, Gas and Electricity. Presented by Hon. Mr. Nantel, January 19, 1914.....*Printed for distribution and sessional papers.*

14. Reports, Returns and Statistics of the Inland Revenues for the Dominion of Canada for the year ended March 31, 1913. Part III.—Adulteration of Food. Presented by Hon. Mr. Nantel, February 11, 1914..... .....*Printed for distribution and sessional papers.*

15. Report of the Minister of Agriculture for the Dominion of Canada, for the year ended March 31, 1913. Presented by Hon. Mr. Burrell, January 22, 1914 .
Printed for distribution and sessional papers.

CONTENTS OF VOLUME 11.

15*a*. Report of the Dairy and Cold Storage Commissioner for the fiscal year ended March 31, 1913. (Dairying, Fruit, Extension of Markets and Cold Storage.) Presented by Hon. Mr. Burrell, May 5, 1914..... .....*Printed for distribution and sessional papers.*

15*b*. Report of the Veterinary Director General for the year ending March 31, 1913. Presented by Hon. Mr. Burrell, February 2, 1914.. *Printed for distribution and sessional papers.*

16. Report of the Director and Officers of the Experimental Farms for the years ending March 31, 1913. Presented by Hon. Mr. Burrell, April 7, 1914.
Printed for distribution and sessional papers.

CONTENTS OF VOLUME 12.

17. Criminal Statistics for the year ended September 30, 1912. (Appendix to the Report of the Minister of Trade and Commerce, for the year 1912.) Presented by Hon. Mr. Foster, February 20, 1914.....*Printed for distribution and sessional papers.*

18. Résumé of General Elections of 1896, 1900, 1904, 1908 and 1911, and of By-Elections held between July 11, 1896 and January 1, 1914. Presented by Hon. r. Coderre, January 27, 1914.....*Printed for distribution and sessional papers.*

18*a*. Return of By-elections for the House of Commons of Canada, held during the year 1913. Presented by Hon. Mr. Coderre, January 27, 1914.
Printed for distribution and sessional papers.

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19. Report of the Minister of Public Works on the works under his control for the fiscal year ended March 31, 1913. Presented by Hon. Mr. Rogers, January 19, 1914.
Printed for distribution and sessional papers.

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20. Report of the Department of Railways and Canals, for the fiscal period from April 1, 1912, to March 31, 1913. Presented by Hon. Mr. Reid, March 20, 1914.
Printed for distribution and sessional papers.

20*a*. Canal Statistics for the season of Navigation, 1913. Presented by Hon. Mr. Reid, March 12, 1914.....*Printed for distribution and sessional papers.*

20*b*. Railway Statistics of the Dominion of Canada for the year ended June 30, 1913. Presented by Hon. Mr. Cochrane, January 29, 1914.
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20*c*. Eighth Report of the Board of Railway Commissioners for Canada, for the year ending March 31, 1913. Presented by Hon. Mr. Cochrane, January 22, 1914.
Printed for distribution and sessional papers.

20*d*. Telephone Statistics of the Dominion of Canada, for the year ended June 30, 1913. Presented by Hon. Mr. Cochrane, February 10, 1914.
Printed for distribution and sessional papers.

20*e*. Express Statistics of the Dominion of Canada, for the year ended June 30, 1913. Presented by Hon. Mr. Cochrane, February 20, 1914.
Printed for distribution and sessional papers.

20*f*. Telegraph Statistics of the Dominion of Canada, for the year ended June 30, 1913. Presented by Hon. Mr. Cochrane, February 10, 1914.
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21. Forty-sixth Annual Report of the Department of Marine and Fisheries, for the year 1912-1913.—Marine. Presented by Hon. Mr. Hazen, February 2, 1914.
Printed for distribution and sessional papers.

21*b*. List of Shipping issued by the Department of Marine and Fisheries, being a list of vessels on the Registry Books of the Dominion of Canada, on December 31, 1913. Presented by Hon. Mr. Hazen, May 1, 1914.....*Printed for distribution and sessional papers.*

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22. Forty-sixth Annual Report of the Department of Marine and Fisheries, 1912-13.—Fisheries. Presented by Hon. Mr. Hazen, January 19, 1914.
Printed for distribution ana sessional papers.

23. Supplement to the Forty-sixth Annual Report of the Department of Marine and Fisheries for the fiscal year 1912-13.—Steamboat Inspection Report. Presented by Hon. Mr. Hazen, March 27, 1914.....*Printed for distribution and sessional papers.*

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24. Report of the Postmaster General, for the year ended March 31, 1913. Presented by Hon. Mr. Pelletier, March 12, 1914.....*Printed for distribution and sessional papers.*

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(This volume is bound in two parts.)

25. Annual Report of the Department of the Interior, for the fiscal year ending March 31, 1913. —Volume I. Presented by Hon. Mr. Roche., February 23, 1914.
Printed for distribution and sessional papers.

25. Annual Report of the Department of the Interior, for the fiscal year ending March 31, 1913. —Volume II. Presented by Hon. Mr. Roche, March 9, 1914.
Printed for distribution and sessional papers.

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25*c*. Report of Progress of Stream Measurements, for the calendar year 1913, prepared under the direction of F. H. Peters, C.E., Commissioner of Irrigation. Presented by Hon. Mr. Roche, March 26, 1914.....*Printed for distribution and sessional papers.*

25*d*. Twelfth Report of the Geographic Board of Canada, for the year ending June 30, 1913. Presented by Hon. Mr. Roche, February 2, 1914.
Printed for distribution and sessional papers.

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25*e*. Manitoba Water-powers,

25*f*. Railway Belt Hydrographic Survey for 1911-1912. Presented, 1914.

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26. Summary Report of the Geological Survey, Department of Mines, for the calendar year 1912. Presented by Hon. Mr. Coderre, 1914.
Printed for distribution and sessional papers.

26*a*. Summary Report of the Mines Branch for the calendar year 1912. Presented 1914.
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27. Report of the Department of Indian Affairs for the year ended March 31, 1913. Presented by Hon. Mr. Roche, January 27, 1914.....*Printed for distribution and sessional papers.*

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28. Report of the Royal Northwest Mounted Police, 1913. Presented by Hon. Mr. Borden, January 19, 1914.....*Printed for distribution and sessional papers.*

28*a*. Statement of Magisterial cases entered, and convictions obtained by the Royal Northwest Mounted Police in the Provinces of Alberta and Saskatchewan, the Yukon Territory and a portion of Manitoba, during the years 1909 to 1913. Presented by Hon. Mr. Borden, February 16, 1914.....*Not printed.*

29. Report of the Secretary of State of Canada for the year ended March 31, 1913. Presented by Hon. Mr. Coderre, February 9, 1914....*Printed for distribution and sessional papers.*

29*a*. Report of the Secretary of State for External Affairs for the year ended March 31, 1913. Presented by Hon. Mr. Borden, January 19, 1914.
Printed for distribution and sessional papers.

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29*c*. Documents *re* Constitutional History of Canada.—(Senate).
Printed for distribution and sessional papers.

29*c*. Public Archives.—Documents relating to the Constitutional History of Canada, 1791-1818, selected and edited with notes by Arthur G. Doughty and Duncan A. McArthur. Presented by Hon. Mr. Coderre, March 27, 1914.
Printed for distribution and sessional papers.

CONTENTS OF VOLUME 26.

30. The Civil Service List of Canada, 1913. Presented, 1914.
Printed for distribution and sessional papers.

31. Fifth Annual Report of the Civil Service Commission of Canada for the year ended August 31, 1913. Presented by Hon. Mr. Coderre, March 18, 1914.
Printed for distribution and sessional papers.

32. Annual Report of the Department of Public Printing and Stationery for the fiscal year ended March 31, 1913. Presented by Hon. Mr. Coderre, March 11, 1914.
Printed for distribution and sessional papers.

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33. The Report of the Joint Librarians of Parliament. Presented by the Hon. The Speaker, January 15, 1914.....*Not printed.*

34. Report of the Minister of Justice as to Penitentiaries of Canada, for the fiscal year ended March 31, 1913.....*Printed for distribution and sessioanl papers.*

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35. Report of the Militia Council for the Dominion of Canada, for the fiscal year ending March 31, 1913. Presented by Hon. Mr. Hughes, March 9, 1914.
Printed for distribution and sessional papers.

36. Report of the Department of Labour for the fiscal year ending March 31, 1913. Presented by Hon. Mr. Crothers, January 19, 1914....*Printed for distribution and sessional papers.*

36*a*. Sixth Report of the Registrar of Boards of Conciliation and Investigation of the proceedings under "The Industrial Disputes Investigation Act, 1907," for the fiscal year ending March 31, 1913. Presented by Hon. Mr. Crothers, January 19, 1914.
Printed for distribution and sessional papers.

36*b*. Report on Strikes and Lockouts in Canada, from 1901 to 1912. Presented by Hon. Mr. Crothers, January 19, 1914 .....*Printed for distribution and sessional papers.*

37. Ninth Annual Report of the Commissioners of the Transcontinental Railway, for the year ended March 31, 1913. Presented by Hon. Mr. Cochrane, January 22, 1914.
Printed for distribution and sessional papers.

37*a*. Interim Report of the Commissioners of the Transcontinental Railway, for the nine months ended December 31, 1913. Presented by Hon. Mr. Cochrane, February 18, 1914.
Not printed.

38. Report of the Department of the Naval Service, for the fiscal year ending March 31, 1913. Presented by Hon. Mr. Hazen, January 22, 1914.
Printed for distribution and sessional papers.

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39. A detailed statement of all bonds or securities registered in the Department of the Secretary of State of Canada, since last return (4th December, 1912) submitted to the Parliament of Canada under Section 32 of Chapter 19, of the Revised Statutes of Canada, 1906. Presented by Hon. Mr. Coderre, January 22, 1914.....*Not printed.*

40. Return to an Order of the House of April 7, 1913, for a copy of all accounts, vouchers and charges incurred by and relating to the Lobster Hatchery and Patrol Boat *Davis* during the season of 1912, to December 31, 1912, with the names of the officers and crews, and the wages paid to each. Presented January 19, 1914.—*Mr. Kyte*.....*Not printed.*

41. Return to an Order of the House April 21, 1913, for a Return showing the names and the respective ranks and positions of the officers now on duty on the *Niobe* at Halifax, under the Department of Naval Affairs; the number of men now on duty as seamen or other like positions on the *Niobe*; the number of men dropped from the service on the *Niobe* since July 1, 1912; and if any efforts have been made to recruit men for the *Niobe* since July 1, 1912. Presented January 19, 1914.—*Mr. Macdonald*...*Not printed.*

42. Return to an Order of the House of May 12, 1913.—1. For a Return showing the respective names, duties and salaries of Officials of the Immigration Department of both Inside and Outside Service on March 31, 1911.

2. The respective names, duties and salaries of Officials of the Immigration Department of both Inside and Outside Service on March 31, 1913. Presented January 19, 1914.—*Mr. Oliver* ..... *Not printed.*

43. Return to an Order of the House of February 24, 1913, for a copy of all regulations relating to the disposition of Dominion Lands made by the Minister of the Interior from October 12, 1911, to January 1, 1912, and of the regulations for the placing of half-breed scrip on homestead or other lands, made by the Minister of the Interior from October 12, 1911, to January 1, 1912. Presented January 19, 1914.—*Mr. Oliver.*
Not printed.

44. Return to an Order of the House of January 15, 1913, for a copy of all charges, correspondence, letters, telegrams nd other documents relative to the dismissal of Horace Rindress, Quarantine Medical Officer at North Sydney, in the Riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expenses of such investigation. Presented January 19, 1914.—*Mr. McKenzie*.....*Not printed.*

44*a*. Supplementary Return to an Order of the House of December 11, 1912, for a copy of all papers, documents and correspondence relating to the dismissal of A. T. Doucet, Postmaster and Collector of Customs at Salmon River, Digby County, N.S. Presented January 19, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

44*b*. Return to an Order of the House of April 21, 1913, for a copy of the charges made against Alexis Bourque, Storm Signal Agent at Bonaventure, on which he was dismissed by the Minister of Marine and Fisheries, and a copy of all letters and other documents bearing on the appointment of his successor. Presented January 23, 1914.—*Mr. Marcil (Bonaventure)*..... ..... *Not printed.*

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44*c*. Return to an Order of the House of January 29, 1913, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Department of Marine and Fisheries, or any Department of the Government, relating to the dismissal of Patrick Conway, Lightkeeper at White Head Island, N.S., and if there was an investigation the names of the witnesses, a copy of the evidence, and a detailed statement of the expenses of such investigation. Presented January 21, 1914.—*Mr. Sinclair*..... *Not printed.*

44*d*. Return to an Order of the House of May 7, 1913, for a copy of all papers, documents, telegrams and correspondence in connection with the dismissal of Captain Wm. Smith, Coxswain, of the lifeboat at Blanche, Shelburne County, N.S. Presented January 21, 1914.—*Mr. Law*..... *Not printed.*

44*e*. Return to an Order of the House of March 3, 1913, for a Return showing in detail the number of dismissals from public offices and positions of employment by the present Government since the 11th day of October, 1911, to this date, in the County of King's, Province of Nova Scotia, in connection with any of the Departments of the public service, not including cases in which orders have already passed; together with the names of the dismissed officials or employees, the reason for their respective dismissals, the complaints or charges against them, and by whom made; together with a copy of all correspondence, letters, telegrams and other communications with respect to each such case of dismissal, and of all minutes of evidence of investigations, where any such were held, and of all reports relating to such dismissals now in the possession of any of the Departments of the Government, also the names of all parties appointed to fill the vacancies caused by such dismissals, and the names of the persons by whom the same have been respectively recommended for appointment; together with a detailed statement of all amounts and expenses paid, or to be paid, by any Department in connection with the said dismissals and investigations or removals from office. Presented January 21, 1914.—*Mr. McKenzie*.....*Not printed.*

44*f*. Return to an Order of the House of the 23rd April, 1913, for a copy of the charges made by Messrs. J. A. Mousseau, A. Godbout and J. Blondin, against Jos. E. A. Landry, keeper of the lighthouse at St. Omer, Quebec, on which he was dismissed for alleged political partisanship. Presented January 21, 1914.—*Mr. Marcil (Bonaventure)*. *Not printed.*

44*g*. Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Colin McIsaac, preventive officer at Port Hood, Inverness County, N.S. Presented January 21, 1914.—*Mr. Chisholm (Inverness)*.....*Not printed.*

44*h*. Return to an Order of the House of the 19th May, 1913, for a copy of all petitions and correspondence relating to the dismissal of Mr. Pesha, postmaster at Kent Bridge, Ontario. Presented January 22, 1914.—*Sir W. Laurier*.....*Not printed.*

44*i*. Return to an Order of the House of the 29th January, 1913, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Post Office Department or any department of the Government, relating to the dismissal of John F. Reeves, postmaster at Mulgrave, N.S., and if there was an investigation, the names of all witnesses examined, a copy of the evidence, and a detailed statement of the expenses of such investigation. Presented January 22, 1914.—*Mr. Sinclair*..... *Not printed.*

44*j*. Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Havelock McLeod, postmaster at Big Intervale, North East Margaree, Inverness County, Nova Scotia. Presented January 22, 1914.—*Mr. Chisholm (Inverness)*.....*Not printed.*

44*k*. Return to an Order of the House of the 21st April, 1913, for a copy of all documents, petitions, correspondence, messages, inquiries, reports, &c., relating to the dismissal of S. Lapointe, postmaster of St. Eloi, County of Temiscouata, and to the appointment of his successor. Presented January 22, 1914.—*Mr. Gauvreau*.....*Not printed.*

44*l*. Return to an Order of the House of the 3rd February, 1913, for a copy of all correspondence, letters, telegrams and other documents relative to the dismissal of William Bow, postmaster at Winchester Village, County of Dundas, and of all recommendations for the appointment of his successor. Presented January 22, 1914.—*Mr. MacNutt*. *Not printed.*

44*m*. Return to an Order of the House of the 26th March, 1913, for a copy of all charges, correspondence, letters, telegrams, petitions and other documents relating to the dismissal of Mrs. Ellen O'Neil, postmistress at O'Neil's post office, Parish of Moncton, County of Westmorland, New Brunswick, and of all evidence, if any, taken in regard to the same, and of all reports concerning same; and also a copy of all recommendations, correspondence, letters, telegrams, petitions and other documents relating to the appointment of a successor, or of Robert C. Kelly as postmaster of or at the said O'Neil post office, and of all reports, if any, as to the proper location of the office. Presented January 22, 1914. —Mr. Emmerson .....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

44*n*. Return to an Order of the House of the 21st April, 1913, for a copy of the charges made against Alex. Labillois, postmaster of Miguasha, on which his dismissal took place, and of all letters and documents regarding the appointment of John Caissy in his place. Presented January 22, 1914.—*Mr. Marcil (Bonaventure)*.....*Not printed.*

44*o*. Return to an Order of the House of the 21st April, 1913, for a copy of all letters and other documents containing evidence or charges against Madame Z. Marcotte, postmistress of Nouvelle West, Bonaventure County, on which the Postmaster General acted in removing her from office, and also of letters and other documents regarding the appointment of Mr. Lazare Fallu in her stead. Presented January 22, 1914.—*Mr. Marcil (Bonaventure)*.....*Not printed.*

44*p*. Return to an Order of the House of the 28th April, 1913, for a copy of all complaints, accusations, correspondence, petitions, and telegrams respecting the dismissal of Joseph Verault, postmaster at Guay, County of Lévis, of the evidence and report made following the inquiries held by the inquiring Commissioner Smith and the inquiring Commissioner Jolicœur in this matter; also the names of the witnesses summoned and heard, with a copy of the evidence heard at each inquiry, the names of those who represented the Government at these inquiries, and a detailed statement of the expenses caused by these inquiries, with a copy of all documents respecting the appointment of his successor, such as petitions, letters of recommendation, &c. Presented January 22, 1914.—*Mr. Bourassa*.....*Not printed.*

44*q*. Return to an Order of the House of the 2nd June, 1913, for a copy of all telegrams, papers and correspondence in the possession of the Post Office Department, or with any of the officials thereof, regarding the removal from office of the postmaster of Osage, Saskatchewan, and of the appointment of a successor thereto; and of all correspondence bearing upon the said removal or appointment with the post office inspector for that portion of the province of Saskatchewan, and of all other letters and documents with respect thereto. Presented January 22, 1914.—*Mr. Carvell*.....*Not printed.*

44*r*. Return to an Order of the House of the 29th January, 1913, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Post Office Department, or any department of the Government, relating to the dismissal of George Taylor, postmaster at Bickerton, N.S., and if there was an investigation, the names of all witnesses examined, a copy of the evidence and a detailed statement of the expenses of such investigation. Presented January 22, 1914.—*Mr. Sinclair*.....*Not printed.*

44*s*. Return to an Order of the House of the 21st April, 1913, for a copy of all correspondence, telegrams, complaints, affidavits, reports, recommendations, requests, certificates and other documents, relating to the dismissal of Mademoiselle Paul Hus, as postmistress of the Parish Ste. Victoire, County of Richelieu, and the appointment of Mr. Paul Bardier, of the same place, as postmaster. Presented January 22, 1914.—*Mr. Cardin.*
Not printed.

44*t*. Return to an Order of the House of the 3rd March, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Parker S. Hart, postmaster at South Manchester, Guysborough County, N.S., and of all evidence taken and report of investigation held by H. P. Duchemin in regard to the same, and also a detailed statement of the expenses of such investigation. Presented January 22, 1914.—*Mr. Sinclair*.....*Not printed.*

44*u*. Return to an Order of the House of the 17th February, 1913, for a copy of all complaints and charges made against Charles L. Gass, late postmaster at Bayfield, Antigonish County, of the evidence taken, if any, before Commissioner Duchemin, and of his report thereon, and of all letters, telegrams and documents of every kind relating to his dismissal and the appointment of his successor. Presented January 22, 1914.—*Mr. Chisholm (Antigonish)*.....*Not printed.*

44*v*. Return to an Order of the House of the 27th January, 1913, for a copy of all documents, correspondence, letters, reports, &c., relating to the dismissal of Madame Belzil, postmistress at St. Octave, County of Rimouski, and the appointment of her successor. Presented January 22, 1914.—*Mr. Lapointe (Kamouraska)*.....*Not printed.*

44*w*. Return to an Order of the House of the 9th April, 1913, for a copy of all charges, correspondence, telegrams and other documents relating to the dismissal of John McDonnell, postmaster at Essex, Inverness County, Nova Scotia. Presented January 22, 1914.—*Mr. Chisholm (Inverness)*.....*Not printed.*

44*x*. Return to an Order of the House of the 31st March, 1913, for a copy of all letters, telegrams and documents in connection with the dismissal of James Bain, from the postmastership of Ninga post office, Ninga, Manitoba. Presented January 22, 1914.—*Mr. Terriff*.....*Not printed.*

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44*y*. Return to an Order of the House of the 9th April, 1913, for a copy of all letters, petitions, telegrams, complaints, reports and other papers and documents in the possession of the Post Office Department, relating to the dismissal of William McKinnon, postmaster at Erinville, Guysborough County, N.S., and the appointment of Daniel Kenny as successor; and if there was an investigation in connection with the dismissal of the said William McKinnon, the names of all witnesses examined, a copy of the evidence and report of the commissioner, and a detailed statement of the expenses of such investigation. Presented January 22, 1914.—*Mr. Sinclair*.....*Not printed.*

44*z*. Return to an Order of the House of the 7th May, 1913, for a copy of all correspondence, evidence and reports in connection with the dismissal of J. N. Cloutier, postmaster at St. Benoit Labre, County of Beauce, Quebec. Presented January 22, 1914.—*Mr. Béland.* *Not printed.*

44 (2*a*). Return to an Order of the House of the 12th February, 1913, for a copy of all letters, telegrams, papers and documents relative to the dismissal of Mrs. Weave, postmistress at Coal Creek, Queens County, N.B., and of the appointment of Michael L. Knox. Presented January 22, 1914.—*Mr. McLean (Sunbury)*.....*Not printed.*

44 (2*b*). Return to an Order of the House of the 26th May, 1913, for a copy of all correspondence and documents of any kind whatsoever relating to the dismissal of postmasters in Bonaventure County, by the present administration, not already ordered and brought down. Presented January 22, 1914.—*Mr. Marcil (Bonaventure)*.....*Not printed.*

44 (2*c*). Return to an Order of the House of the 28th April, 1913, for a copy of all petitions, complaints, and correspondence containing any charges against Alexander Fraser, postmaster at Fraser's Grant, Antigonish County, N.S., and of all other documents and correspondence on the file in relation thereto. Presented January 22, 1914.—*Mr. Chisholm (Antigonish)*.....*Not printed.*

44 (2*d*). Partial return to an Order of the House of the 10th December, 1912, for a return showing all public officers removed by the present Government in the District of Portneuf, together with the name and duties of each person, the reasons for their dismissal, the nature of the complaints brought against them, also a copy of all correspondence relating thereto and reports of inquiries in cases where such were held. Presented January 22, 1914.—*Mr. Delisle*..... *Not printed.*

44 (2*e*). Return to an Order of the House of the 15th January, 1913, for a return showing a list of the postmasters dismissed or removed by the present Government in the County of Two Mountains, the names of such persons, the reason for their dismissal, the nature of the complaints brought aginst them, and a copy of all correspondence and petitions relating thereto, and reports of inquiry in the cases where such have been held; also the names of their successors. Presented January 22, 1914.—*Mr. Ethier*....*Not printed.*

44 (2*f*). Return to an Order of the House of the 15th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of Thomas Chalmer McLean, postmaster at Ivera, Middle River, Riding of North Cape Breton and Victoria, N.S., and of the evidence taken and reports of investigation held by H. P. Duchemin in regard to the same, and a detailed statement of the expenses of such investigation. Presented January 22, 1914.—*Mr. McKenzie*.....*Not printed.*

44 (2*g*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, telegrams, reports and other documents relative to the dismissal of C. P. Blanchard, postmaster at Truro, Nova Scotia, and the appointment of his successor. Presented January 22, 1914.—*Mr. Macdonald*.....*Not printed.*

44 (2*h*). Return to an Order of the House of the 29th January, 1913, for a copy of all papers, documents, evidence, reports, letters, correspondence, &c., relating to the dismissal of Samuel Atwood, Atwood's Brook, Shelburne County, N.S. Presented January 22, 1914.—*Mr. Law*.....*Not printed.*

44 (2*i*). Return to an Order of the House of the 3rd February, 1913, for a return showing the names of the postmasters in the County of Berthier dismissed since the 21st September, 1911; their respective parishes, the date of their dismissals and the reason alleged; if an inquiry was held in each case; on whose recommendation were these dismissals made; the names of those appointed as their successors and on whose recommendation were they appointed. Presented January 22, 1914.—*Mr. Béland*.....*Not printed.*

44 (2*j*). Return to an Order of the House of the 3rd March, 1913, for a copy of all complaints, accusations, correspondence, petitions and telegrams, respecting the dismissal of Wilfrid Pellemarre, postmaster at Hervey Junction, County of Portneuf, and of all documents respecting the appointment of his successor, such as petitions, letters of recommendation, &c., and also of the evidence and reports made after the inquiry held by the inquiring commissioner; together with a detailed statement of the expenses caused by this inquiry. Presented January 22, 1914.—*Mr. Delisle*.....*Not printed.*

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44 (2*k*). Return to an Order of the House of the 16th February, 1913, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Post Office Department, or any department of the Government, relating to the dismissal of Rufus D. Carrigan, postmaster at Sand Point, Guysborough County, N.S., and if there was an investigation, the names of all witnesses examined, and a detailed statement of the expenses of such investigation. Presented January 22, 1914.—*Mr. Sinclair* ..... *Not printed.*

44 (2*l*). Return to an Order of the House of the 15th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of Daniel Dunlop, postmaster at New Campbellton, Riding of North Cape Breton and Victoria, N.S., and of the evidence taken and reports of the investigation held by H .P. Duchemin in regard to the same, and a detailed statement of the expenses of such investigation. Presented January 22, 1914.—*Mr. McKenzie*..... *Not printed.*

44 (2*m*). Return to an Order of the House of the 9th April, 1913, for a copy of all charges, correspondence, telegrams and other documents relating to the dismissal of Duncan Cameron, postmaster at Craigmore, Inverness County, Nova Scotia. Presented January 22, 1914. —*Mr. Chisholm (Inverness)*..... *Not printed.*

44 (2*n*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, telegrams, reports, charges and other documents relating to the dismissal of Angus Cameron, late postmaster at Fairlight, Sask., and of the evidence taken at the investigation held by Mr. Dorsett. Presented January 22, 1914.—*Mr. Turriff*.... *Not printed.*

44 (2*o*). Return to an Order of the House of the 15th January, 1913, for a copy of all documents, correspondence, petitions and telegrams respecting the dismissal of M. Sauriol, postmaster of St. Janvier, County of Terrebonne, and the appointment of his successor. Presented January 22, 1914.—*Mr. Ethier*..... *Not printed.*

44 (2*p*.) Return to an Order of the House of the 2nd June, 1913, for a copy of all petitions, letters, telegrams and resolutions in connection with the changes made in the names of the post offices at Letches Creek Crossing and Letches Creek, North Cape Breton, N.S., the dismissal of Donald Johnston, the former postmaster at Letches Creek, and the appointment of his successor. Presented January 22, 1914.—*Mr. McKenzie.* *Not printed.*

44 (2*q*). Return to an Order of the House of the 27th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of James McLees, postmaster at Bishop Mills, County of Grenville, Province of Ontario, and the appointment of his successor. Presented January 22, 1914. —*Mr. Proulx* ..... *Not printed.*

44 (2*r*). Return to an Order of the House of the 9th April, 1913, for a copy of all charges, correspondence, telegrams and other documents relating to the dismissal of Mrs. Sarah C. Rankin, postmistress at S. W. Ridge Mabou, Inverness County, Nova Scotia. Presented January 22, 1914.—*Mr. Chisholm (Inverness)*..... *Not printed.*

44 (2*s*).Partial Return to an Order of the House of the 19th March, 1913, for a Return showing in detail the number of dismissals from the public service during the period from June 23, 1896, to September 21, 1911, in the County of Cumberland, Nova Scotia, in connection with any department of the public service; together with the names of the dismissed officials or employees, their ages at the time of entering the public service, the length of their period of service with dates, the amount of their remuneration, the reason for their respective dismissals, the complaints or charges against them, and by whom made; together with a copy of all correspondence, letters, telegrams and other communication with respect to each such case of dismissal, and of all minutes of evidence on investigation, where any such were held, and of all reports relating to such dismissals now in the possession of any of the departments of the government; also the names of all persons appointed to fill vacancies caused by such dismissals, their ages at the date of appointment, the amount of their remuneration, and the names of the persons by whom the same have been respectively recommended for appointment; together with a detailed statement of all amounts and expenses paid by any department in connection with said dismissals and investigations or removal from office. Presented January 22, 1914.—*Mr. Rhodes*..... *Not printed.*

44 (2*t*). Partial Return to an Order of the House of the 29th April, 1913, for a Return showing all employees of the Dominion dismissed in the County of Three Rivers and St. Maurice since October 15, 1911, to date, the date of dismissal, the employment of each man, the salary he was receiving at the time of his dismissal, the reason for dismissal, whether there has been an investigation or not, with the names and places of residence of the men appointed to replace them. Presented January 22, 1914.—*Mr. Bureau.* *Not printed.*

44 (2*u*). Partial Return to an Order of the House of the 10th December, 1912, for a return showing the number of dismissals from public offices by the present Government to this date in the constituency of Regina, together with the names of the dismissed officials, the reasons for their dismissals, the complaints against such officials, and a copy of all correspondence relating thereto and reports of inquiries in cases where such have been held in respect of the same. Presented January 22, 1914.—*Mr. Martin (Regina).* *Not printed.*

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44 (2*v*). Return to an Order of the House of the 10th December, 1912, for a return showing all the public officers dismissed by the present Government in the electoral district of Kamouraska, with the names and duties of such persons respectively, the reason for their dismissal, the nature of the complaints brought against them, also of all correspondence relating thereto and reports of inquiries in cases where such have been held. Presented January 22, 1914.—*Mr. Lapointe* (*Kamouraska*).....*Not printed.*

44 (2*w*). Partial Return to an Order of the House of the 10th February, 1913, for a return showing in detail the number of dismissals from public offices by the present Government to this date in the County of Prince, Prince Edward Island, giving the names of the dismissed officials, the reasons for their dismissal, the complaints against such officials and a copy of all the correspondence with respect to the same and of all notes of evidence and reports of investigations where such were held; also the names of all parties appointed to fill the vacancies caused by such dismissals and the names of the persons by whom the same have been recommended for appointment. Presented January 22, 1914.—*Mr. Richards*.....*Not printed.*

44 (2*x*). Return to an Order of the House of the 10th December, 1912, for a return showing the detail and number of dismissals from public offices by the present Government to this date in the riding of Strathcona, together with the names of the dismissed occupants, the reasons for their dismissal, the complaints against such officials, and a copy of all correspondence with respect to the same, and of all reports of investigations, where such were held. Presented January 22, 1914.—*Mr. Douglas*.....*Not printed.*

44 (2*y*). Partial Return to an Order of the House of the 10th December, 1912, for a return showing the detail and number of dismissals from public offices by the present Government to this date in the riding of Saltcoats, Sask., together with the names of the dismissed occupants, the reasons for their dismissal, the complaints against such officials, and a copy of all correspondence with respect to the same, and all reports of investigations, in cases where such were held. Presented January 22, 1914.—*Mr. MacNutt.* *Not printed.*

44 (2*z*). Return to an Order of the House of the 28th April, 1913, for a return showing all employees dismissed in the County of Champlain since October 15, 1911, to date, the employment of each man, the salary each was receiving at the time of his dismissal, the reasons for dismissals, whether there has been any investigation or not, with the names and places of residence of the men appointed to replace them. Presented January 22, 1914.—*Mr. Bureau*.....*Not printed.*

44 (3*a*). Return to an Order of the House of the 3rd March, 1913, for a return showing in detail the number of dismissals from public offices and position of employment, by the present Government since the 11th day of October, 1911, to this date, in the County of Cumberland, Nova Scotia, not including those for which returns have already been ordered, in connection with any of the departments of the public service; together with the names of the dismissed officials or employees, the reason for their respective dismissals, the complaints or charges against them, and by whom made; together with a copy of all correspondence, letters, telegrams and other communications with respect to each such case of dismissal, and of all minutes of evidence of investigations, where any such were held, and of all reports relating to such dismissals now in the possession of any of the departments of the government; also the names of all parties appointed to fill the vacancies caused by such dismissals, and the names of the persons by whom the same have been respectively recommended for appointment; together with a detailed statement of all amounts and expenses paid by any department in connection with the said dismissals and investigations or removal from office. Presented January 22, 1914. —*Mr. Kyte*.....*Not printed.*

44 (3*b*). Return to an Order of the House of the 3rd February, 1913, for a return showing in detail the number of dismissals from public offices and positions of employment, by the present Government since the first day of October, 1911, to this date, in the County of Westmorland, New Brunswick, in connection with any of the departments of the public service; together with the names of the dismissed officials or employees, the reason for their respective dismissals, the complaints or charges against them, and by whom made, save and except the case of George H. Cochrane, Collector of Customs at Moncton (the papers for which have been already moved for); together with a copy of all correspondence, letters, telegrams and other communications with respect to each such case of dismissal, and of all minutes of evidence of investigations, where any such were held, and of all reports relating to such dismissals now in the possession of any of the departments of government, or of the Government Railways Managing Board, or of the officials of the Intercolonial and the Prince Edward Island Railway; also the names of all parties appointed to fill the vacancies caused by such dismissals, and the names of the persons by whom the same have been respecitvely recommended for appointment; together with a detailed statement of all amounts and expenses paid by any department in connection with the said dismissals and investigations or removals from office. Presented January 22, 1914.—*Mr. Emmerson*.....*Not printed.*

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44 (3*c*). Partial Return to an Order of the House of the 3rd March, 1913, for a return showing in detail the number of dismissals from public offices and positions of employment by the present Government since the 11th day of October, 1911, to this date, in the County of Annapolis, Nova Scotia, in connection with any of the departments of the public service, but not including cases in which orders have already passed together with the names of the dismissed officials or employees, the reason for their respective dismissals, the complaints or charges against them, and by whom made; together with a copy of all correspondence, letters, telegrams and other communications with respect to each such case of dismissal, and of all minutes of evidence of investigations, where any such were held, and of all reports relating to such dismissals now in the possession of any of the departments of the Government; also the names of all parties appointed to fill vacancies caused by such dismissals ,and the names of the persons by whom the same have been respectively recommended for appointment; together with a detailed statement of all amounts and expenses paid by any department in connection with the said dismissals and investigations or removals from office. Presented January 22, 1914.—*Mr. Chisholm (Antigonish)* ..... *Not printed.*

44 (3*d*). Return to an Order of the House of the 28th April, 1913, for a return showing all employees dismissed in the County of Nicolet since October 15, 1911, to date, the date of dismissal, the employment of each man, the salary he was receiving at the time of his dismissal, the reasons for dismissal, whether there has been an investigation or not, with the names and places of residence of the men appointed to replace them. Presented January 22, 1914.—*Mr. Bureau*..... *Not printed.*

44 (3*e*). Return to an Order of the House of the 29th January, 1913, for a return showing in detail the number of dismissals from public offices by the present Government to this date in the constituency of Victoria, Alberta, together with the names of the dismissed officials, the reason of their dismissal, the complaints against such officials, and a copy of all correspondence with respect to the same and of all notes of evidence and of the reports of investigations where such were held; also the names of all parties appointed to fill the vacancies caused by such dismissals and the names of the persons by whom the same have been recommended for appointment. Presented January 22, 1914.—*Mr. White (Alberta)* ..... *Not printed.*

44 (3*f*). Officials dismissed in the constituency of Shelburne and Queens, N.S.—(Senate). *Not printed.*

44 (3*g*). Postmasters dismissed in the County of Antigonish, N.S.—(*Senate*)..... *Not printed.*

44 (3*h*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams, and other documents relating to the dismissal of Dr. Freeman O'Neil, from the office of port physician at Louisburg, Cape Breton South, Nova Scotia, and of the evidence taken and reports of investigation held by H. P. Duchemin in regard to the same. Presented January 26, 1914.—*Mr. Sinclair.* *Not printed.*

44 (3*i*). Partial Return to an Order of the House of the 3rd March, 1913, for a return showing in detail the number of dismissals from public offices and positions of employment by the present Government since the 11th day of October, 1911, to this date, in the County of Digby, Nova Scotia, in connection with any of the departments of the public service, but not including cases in which orders have already passed; together with the names of the dismissed officials or employees, the reasons for their respective dismissals, the complaints or charges against them, and by whom made; together with a copy of all correspondence, letters, telegrams and other communications with respect to each such case of dismissal, and of all minutes of evidence of investigations, where any such were held, and of all reports relating to such dismissals now in the possession of any of the departments of the Government; also the names of all parties appointed to fill the vacancies caused by such dismissals, and the names of the persons by whom the same have been respectively recommended for appointment; together with a detailed statement of all accounts and expenses paid by any department in connection with the said dismissals and investigations or removals from office. And also—Supplementary return to an Order of the House of the 3rd March, 1913, for a return showing in detail the number of dismissals from public offices and positions of employment by the present Government since the 11th day of October, 1911, to this date, in the County of Digby, Nova Scotia, in connection with any of the departments of the public service, but not including cases in which orders have already passed; together with the names of the dismissed officials or employees, the reasons for their respective dismissals the complaints or charges against them, and by whom made; together with a copy of all correspondence, letters, telegrams and other communications with respect to each such case of dismissal, and of all minutes of evidence of investigations, where any such were held, and of all reports relating to such dismissals now in the possession of any of the departments of the Government; also the names of all parties appointed to fill the vacancies caused by such dismissals, and the names of the persons by whom the same have been respectively recommended for appointment; together with a detailed statement of all accounts and expenses paid by any department in connection with the said dismissals and investigations or removals from office. Presented Janaury 22, 1914.—*Mr. Sinclair* ..... *Not printed.*

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44 (3*j*). Partial Return to an Order of the House of the 3rd March, 1913, for a return showing in detail the number of dismissals from public offices and positions of employment by the present Government since the 11th day of October, 1911, to this date, in the constituency of Queen's, Shelburne, Nova Scotia, in connection with any of the departments of the public service, not including cases in which orders have already been passed; together with the names of the dismissed officials or employees, the reason for their respective dismissals, the complaints or charges against them, and by whom made; together with a copy of all correspondence, letters, telegrams and other communications with respect to each such case of dismissal, and of all minutes of evidence of investigations, where any such were held and of all reports relating to such dismissals now in the possession of any of the departments of the Government, also the names of all parties appointed to fill the vacancies caused by such dismissals, and the names of the persons by whom the same have been respectively recommended for appointment; together with a detailed statement of all amounts and expenses paid by any department in connection with the said dismissals and investigations of removals from office. Presented January 27, 1914.—*Mr. Law*.....*Not printed.*

44 (3*k*). Partial Return to an Order of the House of the 19th March, 1913, for a list of public officers employed in the city of Quebec, in the Departments of Inland Revenue, Railways and Canals, the Transcontinental Railway, Customs, Immigration, Marine and Fisheries, Public Works and Militia, the names and duties of such persons, the reason for their dismissal, the nature of the complaints brought against them, also a copy of all correspondence relating thereto, and of reports of inquiry in the cases where such inquiries were held. Presented January 26, 1914.—*Mr. Lachance*.....*Not printed.*

44 (3*l*). Return to an Order of the House of the 29th January, 1913, for a return showing all the public officers removed by the present Government in the District of L'Assomption, together with the names and duties of such persons, the reasons for their dismissal, the nature of the complaints brought against them; also a copy of all correspondence relating thereto and reports of inquiries in cases where such were held, with the names of the successors of the dismissed officers. Presented January 26, 1914.—*Mr. Seguin.* *Not printed.*

44 (3*m*). Further Supplementary Return to an Order of the House of the 7th February, 1912, for a return showing for each department of the Government the names, post office addresses, offices, employment, and salaries of all persons employed either in the inside or outside service thereof, and of such persons not in the Civil Service, employed by the Government in any department, on the tenth day of October, 1911, who have been removed from office or employment by dismissal; specifying in each case the manner of and grounds of such dismissals and the length of notice given to the persons removed, and also indicating in each case whether an inquiry was or was not held prior to such dismissal. Presented January 26, 1914.—*Mr. Kyte*.....*Not printed.*

44 (3*n*). Supplementary Return to an Order of the House of the 3rd March, 1913, for a return showing in detail the number of dismissals from public offices and positions of employment by the present Government since the 11th day of October, 1911, to this date, in the County of Digby, Nova Scotia, in connection with any of the departments of the public service, but not including cases in which orders have already passed; togeaher with the names of the dismissed officials or employees, the reasons for their respective dismissals, the complaints or charges against them, and by whom made; together with a copy of all correspondence, letters, telegrams and other communications with respect to each such case of dismissal, and of all minutes of evidence of investigations, where any such were held, and of all reports relating to such dismissals now in the possession of any of the departments of the Government; also the names of all parties appointed to fill the vacancies caused by such dismissals, and the names of the persons by whom the same have been respectively recommended for appointment; together with a detailed statement of all accounts and expenses paid by any department in connection with the said dismissals and investigations or removals from office. Presented January 28, 1914. —*Mr. Sinclair*.....*Not printed.*

44 (3*o*). Return to an Order of the House of the 26th May, 1913, for a copy of all correspondence, telegrams, inquiries and reports respecting the dismissal of Philias Hable, lightkeeper at St. Louis de Lotbinière, County of Lotbinière, Quebec. Presented February 4, 1914.—*Mr. Fortier*.....*Not printed.*

44 (3*p*). Return to an Order of the House of the 19th May, 1913, for a copy of all correspondence, complaints, petitions and reports connected with the dismissal of Fishery Overseer Migneault at Seven Islands, and the appointment in his place of Elzear Levesque. Presented February 10, 1914.—*Mr. Béland*.....*Not printed.*

44 (3*q*). Return to an Order of the House of the 28th April, 1913, for a return showing all employees dismissed in the County of Maskinonge, since October 15, 1911, to date, the date of dismissal, the employment of each man, the salary he was receiving at the time of his dismissal, the reasons for dismissal, whether there has been investigation or not, and the names and places of residence of the men appointed to replace them. Presented February 10, 1914.—*Mr. Bureau*.....*Not printed.*

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44 (3*r*). Partial Return to an Order of the House of the 3rd March, 1913, for a return showing in detail the number of dismissals from public offices and positions of employment by the present Government since the 11th day of October, 1911, to this date, in the County of King's, Province of Nova Scotia, in connection with any of the departments of the public service, not including cases in which orders have already passed; together with the names of the dismissed officials or employees, the reason for their respective dismissals, the complaints or charges against them, and by whom made; together with a copy of all correspondence, letters, telegrams and other communications with respect to each such case of dismissal, and of all minutes of evidence of investigations, where any such were held, and of all reports relating to such dismissals now in the possession of any of the departments of the Government, also the names of all parties appointed to fill the vacancies caused by such dismissals, and the names of the persons by whom the same have been respectively recommended for appointment; together with a detailed statement of all amounts and expenses paid, or to be paid, by any department in connection with the said dismissals and investigations or removals from office. Presented February 10, 1914.—*Mr. McKenzie*.....*Not printed.*

44 (3*s*). Return to an Order of the House of the 3rd March, 1913, for a return showing in detail the number of dismissals from public office and positions of employment by the present Government since the 11th day of October, 1911, to this date, in the County of Colchester, Nova Scotia, in connection with any of the departments of the public service; together with the names of the dismissed officials or employees, the reasons for their respective dismissals, the complaints or charges against them, and by whom made; together with a copy of all correspondence, letters, telegrams and other communications with respect to each such case of dismissal, and of minutes of evidence of investigations, where any such were held, and of all reports relating to such dismissals now in the possession of any of the departments of the Government; also the names of all parties appointed to fill the vacancies caused by such dismissals, and the names of the persons by whom the same have been respectively recommended for appointment; together with a detailed statement of all amounts and expenses paid by any department in connection with the said dismissals and investigations or removals from office. Presented February 10, 1914.—*Mr. Macdonald*.....*Not printed.*

44 (3*t*). Return to an Order of the House of the 3rd March, 1913, for a return showing in detail the number of dismissals from public offices and positions of employment by the present Government since the 11th day of October, 1911, to this date, in the County of Hants, Nova Scotia, in connection with any of the departments of the public service, not including cases in which orders have already passed; together with the name of the dismissed officials or employees, the reason for their respective dismissals, the complaints or charges against them, and by whom made; together with a copy of all correspondence, letters, telegrams and other communications with respect to each such case of dismissal, and of all minutes of evidence of investigations, where any such were held, and of all reports relating to such dismissals now in the possession of any of the departments of the Government; also of the names of all parties appointed to fill the vacancies caused by such dismissals, and the names of the persons by whom the same have been respectively recommended for appointment; together with a detailed statement of all amounts and expenses paid by any department in connection with the said dismissals and investigations or removals from office. Presented February 10, 1914.—*Mr. Chisholm (Inverness)*.....*Not printed.*

44 (3*u*). Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, documents, recommendations, and reports concerning the dismissal of Miss Eugenie Dorion, an employee in the office of the post office inspector at Quebec; the reasons for her dismissal, the nature of the complaints brought against her, if any, the names of the persons who brought these complaints, also a copy of all correspnodence relating thereto, and the report of inquriy, if there was one held. Presented February 20, 1914.—*Mr. Wilson (Laval)*.....*Not printed.*

44 (3*v*). Return to Order of the House of the 2nd February, 1914, for a copy of all charges, correspondence, letters, telegrams and other documents in the possession of the Post Office Department, relating to the dismissal of James R. Laing, postmaster at Liscombe, N.S., and of the facts taken, and report of investigation in regard to the same, if any, a detailed statement of the expenses of such investigation, together with a copy of all recommendations, letters, telegrams, and other papers relating to the appointment of his successor. Presented February 23, 1914.—*Mr. Sinclair*.....*Not printed.*

44 (3*w*). Return to an Order of the House of the 5th June, 1913, for a copy of all correspondence, papers, &c., in connection with the dismissal of Mr. A. L. Desève, officer in charge of the fishery hatchery at Magog, Quebec, and the appointment of Mr. L. A. Audet to the said position. Presented February 23, 1914.—*Sir W. Laurier*.....*Not printed.*

44 (3*x*). Return to an Order of the House of the 9th February, 1914, for a copy of all correspondence, telegrams and other documents relating to the removal of Jas. T. Richardson as sub-Collector of Customs at Humboldt, Saskatchewan, and the appointment of a successor. Presented February 23, 1914.—*Mr. Neely*.....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

44 (3*y*). Supplementary Return to an Order of the House of the 10th December, 1912, for a return showing the number of dismissals from public offices by the present Government to this date in the constituency of Regina, together with the names of the dismissed officials, the reasons for their dismissals, the complaints against such officials, and a copy of all correspondence with respect to the same, and of all reports of any investigations held in respect of the same. Presented February 24, 1914.—*Mr. Martin* (*Regina*) ..... *Not printed.*

44 (3*z*). Return to an Order of the House of the 9th February, 1914, for a copy of all papers, documents, correspondence, &c., in connection with the dismissal of Mr. Hicks, of Bridgetown, N.S., from the customs service in 1913. Presented February 24, 1914.—*Mr. Maclean* (*Halifax*) ..... *Not printed.*

44 (4*a*). Return to an Order of the House of the 16th February, 1914, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Customs Department, relating to the dismissal of Ralph Harris, sub-collector of customs at Pelee Island, Ont., and if there was an investigation, the names of all the witnesses, and a copy of the evidence; and also of all the papers connected with the appointment of his successor. Presented February 26, 1914.—*Mr. Clarke* (*Essex*) ..... *Not printed.*

44 (4*b*). Return to an Order of the House of the 16th February, 1914, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Customs Department, relating to the dismissal of Aylmer Orton, customs officer at Windsor, Ont., and if there was an investigation, the names of all the witnesses, and a copy of the evidence; and also of all the papers connected with the appointment of his successor. Presented February 26, 1914.—*Mr. Clarke* (*Essex*). *Not printed.*

44 (4*c*). Return to an Order of the House of the 16th February, 1914, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Customs Department, relating to the dismissal of Frederick Forster, sub-collector of customs at Kingsville, Ont., and if there was an investigation, the names of all the witnesses, and a copy of the evidence; and also of all the papers connected with the appointment of his successor. Presented February 26, 1914.—*Mr. Clarke* (*Essex*) ..... *Not printed.*

44 (4*d*). Return to an Order of the House of the 16th February, 1914, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Interior Department, relating to the dismissal of Andrew Darragh, immigration officer at Windsor, Ont., and if there was an investigation, the names of all the witnesses, and a copy of the evidence; and also of all the papers connected with the appointment of his successor. Presented March 2, 1914.—*Mr. Clarke* (*Essex*). *Not printed.*

44 (4*e*). Return to an Order of the House of the 16th February, 1914, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Interior Department, relating to the dismissal of John Halstead, immigration officer at Windsor, Ont., and if there was an investigation, the names of all the witnesses, and a copy of the evidence; and also of all the papers connected with the appointment of his successor. Presented March 2, 1914.—*Mr. Clarke* (*Essex*). *Not printed.*

44 (4*f*). Return to an Order of the House of the 26th May, 1913, for a copy of all correspondence, telegrams, inquiries, and reports, respecting the dismissal of Napoleon Daigle, lighthouse keeper at Barre à Boulard, Parish of St. Louis de Lotbinière, Quebec. Presented March 2, 1914.—*Mr. Fortier* ..... *Not printed.*

44 (4*g*). Supplementary Return to an Order of the House of the 19th March, 1913, for a return showing in detail the number of dismissals from the public service during the period from June 23, 1896, to September 21, 1911, in the County of Cumberland, Nova Scotia, in connection with any department of the public service; together with the names of the dismissed officials or employees, their ages at the time of entering the public service, the length of their period of service with dates, the amount of their remuneration, the reason for their respective dismissals, the complaints or charges against them, and by whom made; together with a copy of all correspondence, letters, telegrams and other communications with respect to each such case of dismissals, and of all minutes of evidence on investigation, where any such were held, and of all reports relating to such dismissals now in the possession of any of the departments of the government; also the names of all persons appointed to fill vacancies caused by such dismissals, their ages at the date of appointment, the amount of their remuneration, and the names of the persons by whom the same have been respectively recommended for appointment; together with a detailed statement of all amounts and expenses paid by any department in connection with said dismissals and investigations or removal from office. Presented March 2, 1914.—*Mr. Rhodes* ..... *Not printed.*

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44 (4*h*). Return to an Order of the House of the 16th February, 1914, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Department of the Postmaster General, relating to the dismissal of James H. Smart, postmaster at Kingsville, Ont., and if there was an investigation, the names of all the witnesses and a copy of the evidence; and also of all the papers connected with the appointment of his successor. Presented March 2, 1914.—*Mr. Clarke (Essex)* ..... *Not printed.*

44 (4*i*). Return to an Order of the House of the 11th February, 1914, for a copy of all papers, letters and documents of every kind relating to the dismissal of John A. Roy from the position of postmaster at Maitland, County of Hants. Presented March 2, 1914.—*Mr. Macdonald* ..... *Not printed.*

44 (4*j*). Return to an Order of the House of the 11th February, 1914, for a copy of all papers, letters and documents of every kind relating to the dismissal of Thomas Nelson, from the position of postmaster at Scotch Village, County of Hants. Presented March 2, 1914.—*Mr. Macdonald* ..... *Not printed.*

44 (4*k*). Return to an Order of the House of the 11th February, 1914, for a copy of all papers, letters and documents of every kind relating to the dismissal of Albert McHeffey from the position of postmaster at Shubenacadie, County of Hants. Presented March 2, 1914. —*Mr. Macdonald* ..... *Not printed.*

44 (4*l*). Return to an Order of the House of the 11th February, 1914, for a copy of all papers, letters and documents of every kind relating to the dismissal of C. Stewart McPhee from the position of postmaster at Enfield, County of Hants. Presented March 2, 1914.— *Mr. Macdonald* ..... *Not printed.*

44 (4*m*). Return to an Order of the House of the 2nd February, 1914, for a return showing in detail the number of dismissals from public offices and positions of employment by the present Government since the first day of February, 1913, to date, in the County of Westmorland, New Brunswick, in connection with any of the departments of the public service, except the Post Office Department; together with the names of the dismissed officials or employees, the reasons for their respective dismissal, the complaints or charges against them, and by whom made; together with a copy of all correspondence, letters, telegrams and other communications with respect to each such case of dismissal, and of all minutes of evidence of investigations, where any such were held, and of all reports relating to such dismissals now in the possession of any of the departments of the government, or of the Government Railway Managing Board, or of the officials of the Intercolonial and the Prince Edward Island Railways; also the names of all parties appointed to fill the vacancies caused by such dismissals, and the names of the persons by whom the same have been respectively recommended for appointment; together with a detailed statement of all amounts and expenses paid by any department in connection with the said dismissals and investigations or removals from office. Presented March 3, 1914.—*Mr. Emmerson* ..... *Not printed.*

44 (4*n*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of D. Dishaw, employee of the Marine shipyard at Prescott, Ontario. Presented March 3, 1914.—*Mr. Turriff* ..... *Not printed.*

44 (4*o*). Return to an Order of the House of the 11th February, 1914, for a copy of all papers, letters and documents of every kind relative to the dismissal of A. Michael Russell from the position of caretaker of the drill hall at Windsor, County of Hants. Presented March 3, 1914.—*Mr. Maclean (Halifax)* ..... *Not printed.*

44 (4*p*). Return to an Order of the House of the 2nd February, 1914, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Mr. A. Goyette, postmaster at St. Valerien de Milton, Shefford County, Quebec, and of the evidence taken, and of the reports of investigation held by Dr. W. L. Shurtleff in regard to the same. Presented March 5, 1914.—*Mr. Boivin* ..... *Not printed.*

44 (4*q*). Return to an Order of the House of the 21st April, 1913, for a copy of the evidence and report in the investigation held by Mr. W. A. E. Flynn, in the case of P. D. Bourdages, keeper of the lighthouse at Bonaventure Point, Quebec, of the charges made against the said Bourdages by Ovide Bourdages, Raymond Bourdages, Pierre Henry, J. A. Mousseau and D. Champoux. Presented March 5, 1914.—*Mr. Marcil (Bonaventure)* ..... *Not printed.*

44 (4*r*). Return to an Order of the House of the 21st April, 1913, for a copy of the charges made by Messrs. W. S. Montgomery, J. I. Boudreau, N. Bourg, J. A. Mousseau, N. Boudreau, against Louis Bujold, keeper of the lighthouse at Carleton Point, Quebec. Presented March 5, 1914.—*Mr. Marcil (Bonaventure)* ..... *Not printed.*

44 (4*s*). Return to an Order of the House of the 11th February, 1914, for a return showing reasons for the dismissal of Mr. Shinbine, caretaker of the Immigration Hall at Edmonton, the date of his appointment and of dismissal, and salary at time of dismissal; also the name of caretaker appointed in his place, with date of appointment, salary and qualifications. Presented March 6, 1914.—*Mr. Oliver* ..... *Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

44 (4*t*). Return to an Order of the House of the 11th February, 1914, for a return showing the reasons for the dismissal of Mr. Webster, immigration agent at Edmonton; the date of his appointment and of dismissal, and salary at time of dismissal; also the name of the agent appointed in his place, with date of appointment, salary and qualifications? Presented March 6, 1914.—*Mr. Oliver*.....*Not printed.*

44 (4*u*). Return to an Order of the House of the 11th February, 1914, for a return showing reasons for the dismissal of Jacob Mohr, interpreter for the immigration agency at Edmonton; the date of his appointment and of dismissal, and salary at time of dismissal; also the name of the interpreter appointed in his place with date of appointment, salary and qualifications. Presented March 6, 1914.—*Mr. Oliver*.....*Not printed.*

44 (4*v*). Return to an Order of the Houe of the 11th February, 1914, for a return showing reasons for the dismissal of Mr. P. Tomkins, Dominion Lands Agent at Grouard, the date of his appointment and of dismissal, and salary at time of dismissal; also the name of agent appointed in his place, with date of appointment and salary. Presented March 6, 1914.—*Mr. Oliver*.....*Not printed.*

44 (4*w*). Return to an Order of the House of the 2nd February, 1914, for a copy of all documents bearing upon dismissals and appointments of officials of the Inland Revenue Department in Bonaventure County since January 1, 1913, to date; together with a statement showing the salaries, emoluments and amounts paid to the new appointees since appointment, compared with amounts paid officials for corresponding periods in 1911 and 1912. Presented March 6, 1914.—*Mr. Marcil* (*Bonaventure*)....*Not printed.*

44 (4*x*). Return to an Order of the House of the 2nd February, 1914, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Mr. Arthur Dupuis, postmaster at Pontbriand, County of Megantic, Quebec, and of the evidence taken and of the reports of investigation held by Dr. W. L. Shurtleff in regard to the same. Presented March 6, 1914...*Mr. Pacaud*.....*Not printed.*

44 (4*y*). Return to an Order of the House of the 2nd February, 1914, for a copy of all correspondence, letters, telegrams, petitions and other documents relating to the dismissal of Jos. Serguis Archambault, as postmaster of the town of Terrebonne, and to the appointment of George Beausoldeil, as his successor. Presented March 6, 1914. *Mr. Seguin* .....*Not printed.*

44 (4*z*). Return to an Order of the House of the 2nd February, 1914, for a copy of all correspondence, letters, telegrams, reports and all other papers relating to the dismissal of Martin Lanigan, postmaster at Sexton, County of Kent, New Brunswick, and of the minutes of evidence of any investigation or inquiry held relating to the said dismissal, and of all and any charges and recommendations connected therewith; also a copy of all letters written to the Postmaster General or to any official of the Post Office Department, by F. J. Robidoux, M.P., or by any other person relating to the said dismissal. Presented March 6, 1914.—*Mr. Emmerson*.....*Not printed.*

44 (5*a*). Return to an Order of the House of the 2nd February, 1914, for a copy of all documents, letters, correspondence and petitions asking for the dismissal of Mr. Felix Raymond, postmaster at Ste. Scholastique Village, County of Two Mountains, together with everything in connection with such dismissal. Presented March 6, 1914.—*Mr. Ethier.* *Not printed.*

44 (5*b*). Return to an Order of the House of the 16th February, 1914, for a copy of all papers in connection with the sub-lands agency in Gravelburg, Saskatchewan. Presented March 10, 1914.—*Mr. Knowles*.....*Not printed.*

44 (5*c*). Further Supplementary Return to an Order of the House of the 3rd March, 1913, for a return showing in detail the number of dismissals from public offices and positions of employment by the present Government since the 11th of October, 1911, to this date, in the County of King's, Province of Nova Scotia, in connection with any of the departments of the public service, not including cases in which orders have already passed; together with the names of the dismissed officials or employees, the reason for their respective dismissals, the complaints or charges against them, and by whom made; together with a copy of all correspondence, letters, telegrams and other communications with respect to each such case of dismissal, and of all minutes of evidence of investigations, where any such were held, and of all reports relating to such dismissals now in the possession of any of the departments of the Government, also the names of all parties appointed to fill the vacancies caused by such dismissals, and the names of the persons by whom the same have been respectively recommended for appointment; together with a detailed statement of all amounts and expenses paid, or to be paid, by any department in connection with the said dismissals and investigations or removals from office. Presented March 10, 1914.—*Mr. McKenzie*.....*Not printed.*

44 (5*d*). Return to an Order of the House of the 11th February, 1914, for a copy of all papers, telegrams, correspondence and petitions in any way referring to the dismissal of the postmaster at Ainslie Glen, Inverness County, and the appointment of Neil McKinnon to said office. Presented March 12, 1914.—*Mr. Chisholm* (*Inverness*). *Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

44 (5*e*). Return to an Order of the House of the 9th February, 1914, for a copy of all papers, documents, correspondence, letters, &c., since October 1, 1911, relating to the appointment of a postmaster at Upper Ohio, Shelburne County, N.S. Presented March 12, 1914.—*Mr. Maclean* (*Halifax*).....*Not printed.*

44 (5*f*). Return to an Order of the House of the 9th February, 1914, for a copy of all papers, documents, correspondence, letters and telegrams, relating to the dismissal of Jos. H. Lefebvre, postmaster at Howick Station, County of Chateauguay, and the appointment of his successor. Presented March 12, 1914.—*Mr. Robb*.....*Not printed*

44 (5*g*). Return to an Order of the House of the 11th February, 1914, for a copy of all correspondence, letters, telegrams, petitions and other documents in any way connected with the dismissal of the postmaster at Alexander, Inverness County, and the appointment of a successor. Presented March 12, 1914.—*Mr. Chisholm* (*Inverness*).
Not printed.

44 (5*h*). Return to an Order of the House of the 2nd February, 1914, for a copy of all correspondence, letters, telegrams and documents of all kinds in possession of the Government or any department thereof, in any way relating to the employment of and dismissal from the Geological Survey of Canada of N. H. McLeod, North East Margaree, Inverness County, N.S. Presented March 12, 1914.—*Mr. Chisholm* (*Inverness*).
Not printed.

44 (5*i*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of M. Barry, from the service of the Marine Department at Prescott, Ontario. Presented March 17, 1914.—*Mr. Lemieux*.....*Not printed.*

44 (5*j*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of W. Granton, from the service of the Marine Department at Prescott, Ontario. Presented March 17, 1914.—*Mr. Thomson* (*Qu'Appelle*).
Not printed.

44 (5*k*). Return to an Order of the House of the 9th February, 1914, for a copy of all letters, and telegrams in connection with the dismissal of the postmaster at Fletwode, Saskatchewan, and the changing of the location of the said post office. Presented March 17, 1914.—*Mr. Turriff*.....*Not printed.*

44 (5*l*). Return to an Order of the House of the 2nd February, 1914, for a return showing in detail the number of dismissals or removals from office from 1st February, 1913, of postmasters in the County of Westmorland, New Brunswick; together with the names of the dismissed postmasters, or postmistresses, the reason of their dismissal, and a copy of the charges or complaints against such officials respectively, and of all correspondence with respect to the same; and of all correspondence, recommendations, petitions, protests and other documents, and of all notes of evidence and of the reports of investigations, where such were held, relating thereto, or to the appointment of successors to fill such offices respectively; and also the names of all persons appointed to fill the vacancies caused by such dismissals, and of the persons by whom the same respectively were recommended for appointment. Presented March 17, 1914.—*Mr. Emmerson.*
Not printed.

44 (5*m*). Return to an Order of the House of the 16th February, 1914, for a return showing the name of the postmaster of the Parish of St. Henri de Lauzon, County of Lévis, who, it is said, was dismissed from office since September, 1911, the reasons for such dismissal, the nature of the complaints made against him, the names of the parties who made those complaints, together with a copy of all correspondence and telegrams relating thereto, the name of the inquiring commissioner, and report of investigation, if any, and of all evidence taken at the investigation, the names of those who recommended the successor, names of the parties by whom the Government was represented at such investigation, with a detailed statement of all the accounts paid or to be paid by any department in connection with the aforesaid dismissal and investigation, the names of the parties who received any money or filed their accounts in connection with said investigation, and the amount awarded to or claimed by each of them. Presented March 17, 1914.—*Mr. Bourassa*.....*Not printed.*

44 (5*n*). Return to an Order of the House of the 23rd February, 1914, for a copy of all letters, petitions, telegrams, evidence, reports, papers and documents, in the possession of the Post Office Department, or any other department, relating to the dismissal of Geo. Skates, postmaster at Appin, Ontario; and if there was an investigation, the name of the investigator and witnesses, a copy of the evidence and of letters, papers, petitions, recommendations and other documents connected with the appointment of Mr. Skates' successor. Presented March 17, 1914.—*Mr. Ross*.....*Not printed.*

44 (5*o*). Return to an Order of the House of the 9th March, 1914, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Geo. J. Ryan and Charles Hamlin from the Canadian customs service at Newport, Vermont, and of the appointment of Charles A. Boright and Frank S. Baker to the said positions. Presented March 20, 1914.—*Mr. Boivin*.....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

44 (5*p*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations, in any way relating to the dismissal of J. Shaver, employee of the Marine shipyard at Prescott, Ontario. Presented March 20, 1914.—*Mr. Law*.....*Not printed.*

44 (5*q*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of R. Lunay, employee of the Marine shipyard at Prescott, Ontario. Presented March 20, 1914.—*Mr. Carroll*.....*Not printed.*

44 (5*r*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of J. Slattery, employee of the Marine shipyard at Prescott, Ontario. Presented March 20, 1914.—*Mr. Béland*.....*Not printed.*

44 (5*s*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of J. Walsh, employee of the Marine shipyard at Prescott, Ontario. Presented March 20, 1914.—*Mr. Chisholm (Inverness)*.....*Not printed.*

44 (5*t*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of W. Gerts, employee of the Marine shipyard at Prescott, Ontario. Presented March 20, 1914.—*Mr. Wilson (Laval)*.....*Not printed.*

44 (5*u*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of D. Boivard, employee of the Marine shipyard at Prescott, Ontario. Presented March 20, 1914.—*Mr. Kyte*.....*Not printed.*

44 (5*v*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of G. Scott, employee of the Marine shipyard at Prescott, Ontario. Presented March 20, 1914.—*Mr. Nesbitt*.....*Not printed.*

44 (5*w*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of J. Offspring, employee of the Marine shipyard at Prescott Ontario. Presented March 20, 1914.—*Mr. Warnock*.....*Not printed.*

44 (5*x*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of J. Hayes, employee of the Marine shipyard at Prescott, Ontario. Presented March 20, 1914.—*Mr. Turriff*.....*Not printed.*

44 (5*y*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of P. Belanger, from the service of the Marine Department at Prescott, Ontario. Presented March 20, 1914.—*Mr. Proulx*.....*Not printed.*

44 (5*z*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of L. Place, employee of the Marine shipyard at Prescott, Ontario. Presented March 20, 1914.—*Mr. Pacaud*.....*Not printed.*

44 (6*a*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of C. Kavanagh, employee of the Marine shipyard at Prescott, Ontario. Presented March 20, 1914.—*Mr. Carvell*.....*Not printed.*

44 (6*b*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of J. Roche, employee of the Marine shipyard at Prescott, Ontario. Presented March 20, 1914.—*Mr. Sinclair*.....*Not printed.*

44 (6*c*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of J. McInnis, employee of the Marine shipyard at Prescott, Ontario. Presented March 20, 1914.—*Mr. McCoig*.....*Not printed.*

44 (6*d*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of E. Scott, employee of the Marine shipyard at Prescott, Ontario. Presented March 29, 1914.—*Mr. Demers*.....*Not printed.*

44 (6*e*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of C. Wright, employee of the Marine shipyard at Prescott, Ontario. Presented March 20, 1914.—*Mr. Clark (Red Deer)*.....*Not printed.*

44 (6*f*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of L. Lalonde, employee of the Marine shipyard at Prescott, Ontario. Presented March 20, 1914.—*Mr. Bureau*.....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

44 (6*g*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of H. Birks, employee of the Marine shipyard at Prescott, Ontario. Presented March 20, 1914.—*Mr. Charlton*.....*Not printed.*

44 (6*h*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of W. Jarvis, employee of the Marine shipyard at Prescott, Ontario. Presented March 20, 1914.—*Mr. Gauvreau*.....*Not printed.*

44 (6*i*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of J. McDermott, employee of the Marine shipyard at Prescott, Ontario. Presented March 23, 1914.—*Mr. Devlin*.....*Not printed.*

44 (6*j*). Return to an Order of the House of the 27th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of George L. Brown, officer in charge of the Dominion lighthouse, Prescott Depot, Ontario, and the appointment of his successor. Presented March 23, 1914.—*Mr. Proulx*..... *Not printed.*

44 (6*k*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of J. Lane, employee of the Marine shipyard at Prescott, Ontario. Presented March 23, 1914.—*Mr. MacNutt*.....*Not printed.*

44 (6*l*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of D. Perrin, employee of the Marine shipyard at Prescott, Ontario. Presented March 23, 1914.—*Mr. Lemieux*.....*Not printed.*

44 (6*m*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence, and recommendations in any way relating to the dismissal of J. A. Mundle, employee of the Marine shipyard at Prescott, Ontario. Presented March 23, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

44 (6*n*). Return to an Order of the House of the 16th February, 1914, for a return showing the name of the postmaster of the Parish of St. Lambert, County of Lévis, who, it is stated, was dismissed from office since September, 1911, the reasons for such dismissal, the nature of the complaints made against him, the names of the parties who made those complaints, together with a copy of all correspondence and telegrams relating thereto, the name of the inquiring commissioner, and report of investigation, if any, and of all evidence taken at the investigation, the names of those who recommended the successor, names of the parties by whom the Government was represented at such investigation, with a detailed statement of all the accounts paid or to be paid by any department in connection with the aforesaid dismissal and investigation, the names of the parties who received any money or filed their accounts in connection with said investigation, and the amount awarded to or claimed by each of them. Presented March 23, 1914.—*Mr. Bourassa*.....*Not printed.*

44 (6*o*). Return to an Order of the House of the 2nd February, 1914, for a return showing the changes in postmasterships in Bonaventure County from January 1, 1913, to date, with a list of dismissals, and reasons therefor, and of new appointments, also a copy of all reports, correspondence, petitions and documents generally bearing on this subject; together with a list of post office contracts cancelled in said constituency, with reasons therefor, if any, and of new contracts awarded, with the old rate and the new, and whether tenders were called for, in each case, and whether contracts were awarded to lowest tenderer or not. Presented March 23, 1914.—*Mr. Marcil (Bonaventure)*. *Not printed.*

44 (6*p*). Return to an Order of the House of the 2nd February, 1914, for a return of all reports, memorials, correspondence and documents generally, bearing on the dismissal of customs officials in Bonaventure county from January 1, 1913, to date, together with a statement of salaries paid to old and new officials, and a copy of recommendations on which new officials were appointed, if any. Presented March 25, 1914.—*Mr. Marcil (Bonaventure)* .....*Not printed.*

44 (6*q*). Return to an Order of the House of the 2nd February, 1914, for a return showing in detail the number of dismissals from office since October 1, 1911, not already brought down, of postmasters in the County of Albert, New Brunswick, together with the names of the dismissed postmasters, the reason of their dismissal, and a copy of the charges or complaints against such officials respectively, also a copy of all correspondence, recommendations, petitions, protests and other documents, and of all notes of evidence and of the reports of investigations, where such were held with respect to the same or relating thereto, or to the appointment of successors to fill such offices respectively. And also the names of all persons appointed to fill the vacancies caused by such dismissals, and the names of the persons by whom the same were respectively recommended for appointment. Presented March 25, 1914.—*Mr. Emmerson*.....*Not printed.*

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44 (6r). Supplementary Return to an Order of the House of the 3rd March, 1913, for a return showing in detail the number of dismissals from public offices and positions of employment by the present Government since the 11th day of October, 1911, to this date, in the constituency of Queen's, Shelburne, Nova Scotia, in connection with any of the departments of the public service, not including cases in which orders have already been passed; together with the names of the dismissed officials or employees, the reason for their respective dismissals, the complaints or charges against them, and by whom made; together with a copy of all correspondence, letters, telegrams and other communications with respect to each such case of dismissal, and of all minutes of evidence of investigations, where any such were held and of all reports relating to such dismissals now in the possession of any of the departments of the Government, also the names of all parties appointed to fill the vacancies caused by such dismissals, and the names of the persons by whom the same may have been respectively recommended for appointment; together with a detailed statement of all amounts and expenses paid by any department in connection with the said dismissals and investigations or removals from office. Presented March 26, 1914.—*Mr. Law*.....*Not printed.*

44 (6s). Supplementary Return to an Order of the House of the 10th December, 1912, for a return showing all the public officers dismissed by the present Government in the electoral district of Kamouraska, with the names and duties of such persons respectively, the reason for their dismissal, the nature of the complaints brought against them, also of all correspondence relating thereto and reports of inquiries in cases where such have been held. Presented March 26, 1914.—*Mr. Lapointe (Kamouraska)*.....*Not printed.*

44 (6t). Return to an Order of the House of the 16th February, 1914, for a return showing the name of the postmaster of the Parish of Notre Dame de Charny, County of Lévis, who, it is stated, was dismissed from office since September, 1911, the reasons for such dismissal, the nature of the complaints made against him, the names of the parties who made those complaints, together with a copy of all correspondence and telegrams relating thereto, the name of the inquiring commissioner, and report of investigation, if any, and of all evidence taken at the investigation, the names of those who recommended the successor, names of the parties by whom the Government was represented at such investigation, with a detailed statement of all the accounts paid or to be paid by any department in connection with the aforesaid dismissal and investigation, the names of the parties who received any money or filed their accounts in connection with said investigation, and the amount awarded to or claimed by each of them. Presented March 31, 1914.—*Mr. Bourassa* .....*Not printed.*

44 (6u). Return to an Order of the House of the 16th March, 1914, for a copy of all telegrams, letters and correspondence in connection with the dismissal of Charles S. Melanson, postmaster of Corberrie, Digby County, N.S. Presented April 1, 1914.—*Mr. Law* .
Not printed.

44 (6v). Return to an Order of the House of the 11th February, 1914, for a return showing reasons for the dismissal of Gordon McDonald, homestead inspector in the Grouard Land Agency, the date of his appointment and of dismissal, and salary at time of dismissal; also the names of inspector appointed in his place, with date of appointment and salary. Presented April 2, 1914.—*Mr. Oliver*.....*Not printed.*

44 (6w). Return to an Address to His Royal Highness the Governor General of the 17th February, 1913, for a copy of all letters, papers and documents relating to the appointment of W. F. Slack as clerk of works in the Department of Public Works at Ottawa; a copy of the charges against the said W. F. Slack, which were investigated by Honourable F. D. Monk, and of all the letters suspending and re-instating the said W. F. Slack; of the employees memorial, dated May 11, 1912, and addressed to Honourable F. D. Monk; praying for the retention in office of the said W. F. Slack; a copy of the charges investigated by Commissioner R. V. Sinclair, of the evidence taken and the reports made by the said commissioner; and also of all correspondence, requests, recommendations and orders in council relating to the dismissal of the said W. F. Slack. Presented April 2, 1914.—*Mr. Murphy* .....*Not printed.*

44 (6x). Return to an Order of the House of the 28th April, 1913, for a copy of all correspondence, memoranda, reports, telegrams, and of all documents whatsoever, in connection with and having relation to the dismissal of William Brunelle, lighthouse keeper at Pointe à Citrouille, County of Champlain, Province of Quebec. Presented April 2, 1914.—*Mr. Bureau* .....*Not printed.*

44 (6y). Return to an Order of the House of the 23rd March, 1914, for a copy of all documents, correspondence, petitions, recommendations, &c., in connection with the dismissal of Arthur Levesque, light keeper at Grosse Isle, Kamouraska, and with the appointment of his successor? Presented April 7, 1914.—*Mr. Lapointe (Kamouraska)*..*Not printed.*

44 (6z). Return to an Order of the House of the 28th April, 1913, for a copy of all correspondence, memoranda, reports, telegrams and all other documents whatsoever having reference to the dismissal of L. Philippe Carignan, lighthouse keeper at Champlain, County of Champlain. Presented April 2, 1914.—*Mr. Bureau*.....*Not printed.*

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44 (7*a*). Return to an Order of the House of the 23rd March, 1914, for a copy of all documents, petitions, correspondence, recommendations, investigations, &c., in connection with the dismissal of Dominique Levesque, lightkeeper at Rivière Ouelle wharf, County of Kamouraska, and with the appointment of his successor. Presented April 7, 1914.—*Mr. Lapointe (Kamouraska)* ..... *Not printed.*

44 (7*b*). Return to an Order of the House of the 2nd February, 1914, for a return showing in detail the number of dismissals from public offices by the present Government in the electoral district of Shefford from the 1st of October, 1911, not already brought down to the present date; together with the names of the dismissed officers, the reasons for their dismissal, the complaints against such officials, names of the complainants in each case, and the names of their successors in office. Presented April 16, 1914.—*Mr. Boivin.* *Not printed.*

44 (7*c*). Supplementary Return to an Order of the House of the 10th December, 1912, for a return showing all public officers removed by the present Government in the District of Portneuf, together with the names and duties of each person, the reasons for their dismissal, the nature of the complaints brought against them, also a copy of all correspondence relating thereto and reports of inquiries in cases where such were held. Presented April 16, 1914.—*Mr. Delisle* ..... *Not printed.*

44 (7*d*). Return to an Order of the House of the 4th February, 1914, for a copy of all correspondence relative to the dismissal of Alex. W. Finlayson, keeper of light on St. Esprit Island, Richmond County, N.S., and to his resignation and the appointment of a successor. Presented April 17, 1914.—*Mr. Kyte* ..... *Not printed.*

44 (7*e*). Return to an Order of the House of the 4th March, 1914, for a copy of all papers, evidence, &c., in connection with the investigation held by the Department of Marine and Fisheries against the light keeper of Cape Cove, County of Gaspé, in 1911. Presented April 17, 1914.—*Mr. Lemieux* ..... *Not printed.*

44 (7*f*). Return to an Order of the House of the 16th February, 1914, for a copy of all telegrams, correspondence and documents of all kinds in any way relating to the dismissal or suspension from duty of Dan Cormier, an officer in the life-saving station at Eastern Harbour, Inverness County, Nova Scotia. Presented April 21, 1914.—*Mr. Chisholm (Inverness)* ..... *Not printed.*

44 (7*g*). Return to Order of the House of the 16th February, 1914, for a copy of all documents bearing on the appointment and dismissal of Ben. V. Willett, as light keeper at Point Duthie, Quebec, and of the appointment of James Doddridge as his successor, as well as of those bearing on the contemplated removal of that light to Maria wharf. Presented April 21, 1914.—*Mr. Marcil (Bonaventure)* ..... *Not printed.*

44 (7*h*). Return to an Order of the House of the 12th February, 1914, for a return showing the names of the postmasters who have been dismissed in the County of Lévis since the month of September, 1911; the number of the dismissed postmasters, since the month of September, 1911, who have been appointed in the place of postmasters dismissed under the late administration; and the names of the postmasters who were dismissed under the late administration. Presented April 22, 1914.—*Mr. Bourassa.* ..*Not printed.*

44 (7*i*). Return to an Order of the House of the 2nd March, 1914, for a copy of all correspondence, papers, documents, evidence, reports, telegrams, &c., relating to the dismissal of John A. L. McLellan, late Light keeper at Fish Island, Prince Edward Island. Presented April 28, 1914.—*Mr. Hughes (Kings, P.E.I.)* ..... *Not printed.*

44 (7*j*). Return to an Order of the House of the 6th April, 1914, for a copy of all documents bearing on the dismissal of Thomas Le Blanc, as postmaster of Allard, Bonaventure County, and the appointment of his successor. Presented April 30, 1914.—*Mr. Marcil (Bonaventure)* ..... *Not printed.*

44 (7*k*). Return to an Order of the House of the 21st April, 1913, for a copy of all letters, telegrams, petitions, complaints, evidence, reports and other documents relating to the dismissal of William E. Ehler, Lightkeeper, Queensport, N.S., also a detailed statement of the expenses connected with the investigation, distinguishing the allowance paid the commissioner from travelling expenses and witness fees; and of all papers connected with the appointment of Mr. Ehler's successor. Presented May 5, 1914.—*Mr. Sinclair.* *Not printed.*

44 (7*l*). Return to an Order of the House of the 2nd March, 1914, for a copy of all letters, petitions, telegrams, evidence, reports, papers and documents in the possession of the Post Office Department, or any other Department, relating to the dismissal of Samuel Dickson, postmaster at Seaforth, Ontario, and if there was an investigation, the names of the investigator and witnesses, with a copy of the evidence and of all letters, papers, petitions, recommendations, or other documents connected with the appointment of Mr. Dickson's successor. Presented May 8, 1914.—*Mr. Ross* ..... *Not printed.*

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44 (7*m*). Return to an Order of the House of the 6th April, 1914, for a copy of all petitions, letters, complaints and other documents relating to the dismissal of Charles McPherson, postmaster at North Riverside, County of Guysborough, N.S., and of all recommendations and correspondence relating to the appointment of his successor; also a copy of all evidence and of the report of the investigation, if any, and a statement of the expenses of said investigation. Presented May 8, 1914.—*Mr. Sinclair*.....*Not printed.*

44 (7*n*). Return to an Order of the House of the 9th March, 1914, for a copy of all letters, telegrams, petitions, notes of evidence, charges, if any, and other papers and documents relating to the dismissal of Christian L. Ehler, postmaster at Queensport, N.S., and of all correspondence, petitions and other papers and documents relating to the appointment of his successor, with a detailed statement of the expenses of the said investigation, if any. Presented May 11, 1914.—*Mr. Sinclair*.....*Not printed.*

44 (7*o*). Return to an Order of the House of the 12th March, 1914, for a return showing:—

1. Whether Christian L. Ehler, postmaster at Queensport, N.S., has been dismissed; and if so, when?
2. Whether the charges against this postmaster were in writing, and by whom the said charges were signed?
3. What the charges were?
4. Who conducted the investigation, if any?
5. Whether the investigation took place after the dismissal or before?
6. Whether the commissioner recommended the dismissal of this postmaster?
7. The names of the witnesses examined?
8. The expense of the investigation in detail?
9. If the Postmaster General is of the opinion that the evidence taken at the investigation justified this dismissal? Presented May 11, 1914.—*Mr. Sinclair.*

Not printed.

44 (7*p*). Return to an Order of the House of the 19th February, 1913, for a copy of all letters, petitions, telegrams, complaints, findings, reports and other papers in the possession of the Post Office Department, or any Department of the Government, relating to the dismissal or discharge of James White, postmaster at Sidney, British Columbia, and if there was an investigation, the names of the witnesses examined and a detailed statement of the expenses of such investigation; also of all letters, telegrams, recommendations and other papers connected with the appointment of his successor. Presented May 11, 1914.—*Mr. Sinclair*.....*Not printed.*

44 (7*q*). Return to an Order of the House of the 9th March, 1914, for a copy of the petition, recommendations and other correspondence relating to the change in the location of the post office at Mount St. Patrick in South Renfrew, and the dismissal of the postmaster. Presented May 11, 1914.—*Mr. Graham*.....*Not printed.*

44 (7*r*). Return to an Order of the House of the 16th February, 1914, for a copy of all documents bearing on the dismissal of the officer in charge of the Port Daniel West, Quebec, lobster hatchery, Edward Dea, and on the appointment of his successor. Presented May 15, 1914.—*Mr. Marcil (Bonaventure)*.....*Not printed.*

44 (7*s*). Return to an Order of the House of the 20th April, 1914, for a copy of all correspondence in connection with the dismissal of A. C. Cameron of Fairlight, Saskatchewan, from his position as mail contractor. Presented May 16, 1914.—*Mr. Turriff.*

Not printed.

44 (7*t*). Return to an Order of the House of the 16th March, 1914, for a copy of all charges, correspondence, letters, petitions, telegrams and other documents relating to the dismissal of Mr. Geo. F. Payne, postmaster at Granby, Shefford County, Quebec, and of the appointment of his successor, Mr. J. L. Dozois, N.P., and also of the transfer of the said office from the one to the other, together with a copy of the evidence taken at all investigations held in connection with the said dismissal, appointment and transfer, and of the reports of said investigations. Presented May 16, 1914.—*Mr. Boivin.*

Not printed.

44 (7*u*). Return to an Order of the House of the 30th March, 1914, for a return showing the names of the postmasters who have been dismissed from the office since 1900, in the County of Portneuf, the number of investigations and the names of those whose cases were investigated. Presented May 16, 1914.—*Mr. Delisle*.....*Not printed.*

44 (7*v*). Return to an Order of the House of the 23rd March, 1914, for a copy of all letters, telegrams, correspondence, complaints and protests on file, reefrring to the dismissal of the late postmaster at Havre Boucher, N.S., and to the appointment of a successor. Presented May 16, 1914.—*Mr. Chisholm (Antigonish)*.....*Not printed.*

44 (7*w*). Return to an Order of the House of the 6th April, 1914, for a copy of all documents, investigations, reports and letters, concerning the dismissal of William Campbell, light keeper on the wharf at New Richmond, Quebec, and the appointment of James Robertson as his successor; together with a copy of recommendations and the letters respecting the appointment, if any. Presented May 29, 1914.—*Mr. Marcil (Bonaventure).*

Not printed.

CONTENTS OF VOLUME 28—*Continued.*

44 (7*x*). Supplementary Return to an Order of the House of the 2nd February, 1914, for a return showing in detail the number of dismissals from public offices and positions of employment by the present Government since the first day of February, 1913, to date, in the County of Westmorland, New Brunswick, in connection with any of the Departments of the Public Service, except the Post Office Department, together with the names of the dismissed officials or employees, the reasons for their respective dismissal, the complaints or charges against them, and by whom made; together with a copy of all correspondence, letters, telegrams and other communications with respect to each such case of dismissal and of all minutes of evidence of investigations where any such were held and of all reports relating to such dismissals now in the possession of any of the departments of the Government, or of the Government Railway Managing Board, or of the officials of the Intercolonial and the Prince Edward Island Railways; also the names of all parties appointed to fill the vacancies caused by such dismissals, and the names of the persons by whom the same have been respectively recommended for appointment; together with a detailed statement of all amounts and expenses paid by any department in connection with the said dismissals and investigations or removals from office. Presented June 2, 1914.—*Mr. Emmerson*.....*Not printed.*

44 (7*y*). Return to an Order of the House of the 14th April, 1913, for a return showing the detail and number of dismissals from public offices in the Department of Marine and Fisheries from December 5, 1912, to this date, in the County of Bonaventure, the names of the dismissed occupants, the reasons for their dismissal, the complaints against such officials, and a copy of all correspondence with respect to the same, and of all reports of investigations, where such were held; as well as a list of the new appointments made by the department, with names, residence, salaries and duties, and a copy of all recommendations of such appointments. Presented June 2, 1914.—*Mr. Marcil (Bonaventure)*. *Not printed.*

44 (7*z*). Return to an Order of the House of the 4th May, 1914, for a copy of all complaints and other documents bearing upon the dismissal of J. R. Denison as postmaster of Richmond, Quebec, and the appointment of his successor. Presented June 2, 1914.—*Mr. Tobin* ..... *Not printed.*

44 (8*a*). Return to an Order of the House of the 4th May, 1914, for a copy of all correspondence exchanged by and with the Department of Inland Revenue and the late J. G. Mousseau and A. M. Coldwell, New Carlisle, Quebec, and David Champoux, Campbellton, N.B., or Restigouche, Quebec, in connection with the dismissal of Arthur B. Caldwell, Assistant Inspector of Weights and Measures, District of Quebec. Presented June 8, 1914.—*Mr. Marcil*.....*Not printed.*

44 (8*b*). Supplementary Return to an Order of the House of the 3rd March, 1913, for a return showing in detail the number of dismissals from public offices and positions of employment by the present Government since the 11th day of October, 1911, to this date, in the County of Annapolis, Nova Scotia, in connection with any of the departments of the public service, but not including cases in which orders have already passed together with the names of the dismissed officials or employees, the reason for their respective dismissals, the complaints or charges against them, and by whom made; together with a copy of all correspondence, letters, telegrams and other communications with respect to each such case of dismissal, and of all minutes of evidence of investigations, where any such were held, and of all reports relating to such dismissals now in the possession of any of the departments of the government; also the names of all parties appointed to fill vacancies caused by such dismissals, and the names of the persons by whom the same have been respectively recommended for appointment; together with a detailed statement of all amounts and expenses paid by any department in connection with the said dismissals and investigations or removals from office. Presented June 8, 1914.—*Mr. Chisholm (Antigonish)*.....*Not printed.*

44 (8*c*). Partial Return to an Order of the House of the 18th February, 1914, for a copy of all charges, complaints, memorials, correspondence and telegrams, not already produced, relating to officials in any department of the Government since October 10, 1911, the number of officials dismissed, reports of investigations held in respect of such charges, items of expenditure and cost of each investigation, the names of persons appointed to office in the place of dismissed officials, and of all recommendations received in behalf of persons so appointed in the Province of Prince Edward Island. Presented June 12, 1914.—*Mr. Hughes (Kings, P.E.I.)*.....*Not printed.*

44 (8*d*). Return to an Order of the House of the 1st June, 1914, for a copy of all charges and complaints, letters, telegrams and correspondence respecting the dismissal of Captain Jeremiah Decoste, mate and craneman, employed on dredge *No. 6* under Captain Dan Gillis during the season of 1912, and of all representations made and correspondence had with the Department of Public Works, or any officer thereof regarding his re-instatement. Presented June 12, 1914.—*Mr. Chisholm (Antigonish)*....*Not printed.*

45. Return to an Order of the House of the 12th May, 1913, for a copy of all communications made by the Canadian Forestry Association to the Government between March 31, 1912, and March 31, 1913, with the replies made thereto. Presented January 19, 1914.—*Mr. Oliver* ..... *Not printed.*

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46. Return to an Order of the House of the 16th January, 1913, for a return showing the number of bushels of grain and sacks or barrels of flour which were shipped from Fort William and Port Arthur by vessel during 1912, and the different kinds of grain respectively; to what points were the same shipped in Canada and the United States giving quantities and kinds respectively, and at what points in Canada was grain or flour received by vessel from the United States, giving the quantities and kinds respectively. Presented January 19, 1914.—*Mr. Bennett (Simcoe)*.....*Not printed.*

47. Return to an Order of the House of the 7th May, 1913, for a copy of the report concerning Indian Titles which was presented to the Superintendent General of Indian Affairs under date of August 20, 1909. Presented January 19, 1914.—*Mr. Thompson (Yukon)*. *Not printed.*

48. Copy of Order in Council No. P. C. 3002, dated 29th November, 1913, in respect to Pensions or Gratuities to officers of the Royal Canadian Navy, in accordance with section 47 of the Naval Service Act, 1910. Presented by Hon. Mr. Hazen, January 19, 1913. *Not printed.*

49. Return to an Order of the House of the 26th May, 1913, for a copy of all telegrams, letters, &c., from the Department of Customs sent to or received from John C. Bourinot, Port Hawkesbury, customs officer, during the years 1895-6-7. Presented January 19, 1914. —*Mr. Chisholm (Inverness)*.....*Not printed.*

49*a*. Return to an Order of the House of the 26th May, 1913, for a return showing a complete list of the seizures made by John C. Bourinot, during his incumbency as acting preventive officer from 1884 to 1886; also during his term of office as Collector of Customs for the Port of Hawkesbury from 1886 to 1898, also during his term of office of special officer of customs from 1898 to 1912; with the date of each seizure, number of each seizure, name of party from whom seizure was made, in case of vessels, the names of the vessels; also the names of the owners of such vessels, the amount of each seizure, name of port where seizure was made, and the amount of the seizures made by him from 1884 to May 1, 1912, for the whole Province of Nova Scotia. Presented January 19, 1914.—*Mr. Chisholm (Inverness)*.....*Not printed.*

50. Statement of Governor General's Warrants issued since the last session of parliament on account of 1913-14. Presented by Hon. Mr. White, January 19, 1914.....*Not printed.*

51. Statement in pursuance of Section 17 of the Civil Service Insurance Act, for the year ending March 31, 1913. Presented by Hon. Mr. White, January 19, 1914.....*Not printed.*

52. Statement of Superannuation and Retiring Allowances in the Civil Service during the year ending December 31, 1913, showing name, rank, salary, service, allowance and cause of retirement of each person superannuated or retired, also whether vacancy is filled by promotion or by appointment, and salary of any new appointee. Presented by Hon. Mr. White, January 19, 1914.....*Not printed.*

53. Statement of Receipts and Expenditures of the Ottawa Improvement Commission to March 31, 1913. Presented by Hon. Mr. White, January 19, 1914.....*Not printed.*

54. Statement of expenditure on account of "Miscellaneous Unforeseen Expenses," from the 1st April, 1913, to the 14th January, 1914, in accordance with the Appropriation Act of 1912. Presented by Hon. Mr. White, January 19, 1914.....*Not printed.*

55. Statement of the affairs of the Royal Society of Canada, for the year ended April 30, 1913. Presented by Hon. Mr. White, January 19, 1914.....*Not printed.*

56. Statement of Temporary Loans since March 31, 1913. Presented by Hon. Mr. White, January 19, 1914.....*Not printed.*

57. Statement of Treasury Bills discounted since March 31, 1913. Presented by Hon. Mr. White, January 19, 1914.....*Not printed.*

58. Certified List of Shareholders of the Montreal City and District Savings Bank, and La Caisse D'Economie de Notre Dame de Quebec, as on the 31st December, 1913. Presented by Hon. Mr. White, January 19, 1914.....*Not printed.*

59. Copies of General Orders promulgated to the militia for the period between November 18, 1912, and November 25, 1913. Presented by Hon. Mr. Hughes, January 19, 1914. *Not printed.*

60. Return to an Order of the House of the 30th April, 1913, for a copy of the report made by the Inquiring Commissioner, Mr. J. H. Bergeron, in the inquiry lately held by him, at Quebec, *re* Doctor J. D. Page, of Quebec ,and of the reports made by the advocate of the complainant and defendant in the same cause at the request of the Inquiring Commissioner. Presented January 20, 1914.—*Mr. Boulay*.....*Not printed.*

61. Return to an Order of the House of the 26th March, 1913, for a copy of all petitions, reports, recommendations, correspondence, letters, telegrams and other communications concerning the east half of section 36, in township 6, range 8, west of the fourth meridian. Presented January 20, 1914.—*Mr. Buchanan*.....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

61a. Return to an Order of the House of the 24th February, 1913, for a copy of all memoranda, letters, papers, or other documents in the possession of the Department of the Interior relating to the N.W. ¼ of 8-49-23-4, and the S.W. ¼ of 7-49-28-4. Presented January 20, 1914.—*Mr. Oliver*.....*Not printed.*

62. Return to an Order of the House of the 22nd January, 1913, for a copy of all correspondence, &c., exchanged between the Minister of Labour and the Canadian Pacific Railway strikers on their application for a Board of Conciliation and Investigation. Presented January 20, 1914.—*Mr. Lemieux*.....*Not printed.*

63. By-laws of the Moravian Indians of the Thames and Regulations of the Abenakis Indians of St. Francis, approved by His Excellency the Administrator in Council on the 27th March, 1913, and the 21st April, 1913, respectively. Presented by Hon. Mr. Coderre, January 20, 1914.....*Not printed.*

64. General Rules and Orders of the Exchequer Court of Canada made, respectively, on the 24th September, 1913, and the 13th December, 1913. Presented by Hon. Mr. Coderre, January 20, 1914.....*Not printed.*

65. Regulations under "The Destructive Insect and Pest Act."—(*Senate*).....*Not printed.*

66. Remission of Duties and refund under Section 92, Audit Act.—(*Senate*).....*Not printed.*

67. Return to an Order of the House of the 19th May, 1913, for a return showing a comparative and detailed statement of costs of production, maintenance, operation, and management, and receipts of the Dog Fish Reduction Works at Clark's Harbour, N.S., for the years 1910, 1911 and 1912. Presented January 21, 1914.—*Mr. Maclean (Halifax)*. *Not printed.*

68. Return to an Order of the House of the 21st May, 1913, for a copy of all papers, letters, documents, contracts, settlements, records of settlements, and all other papers and documents in any way relating to the claim of the Rainy River Navigation Company against the Government, arising out of a subsidy agreement for the operation of certain boats between Fort Frances and Kenora for the season of 1911, or in connection with the settlement of the said claim, or of the said subsidy. Presented January 21, 1914.—*Mr. Maclean (York)*.....*Not printed.*

69. Return to an Order of the House of the 31st March, 1913, for a copy of all correspondence, letters, telegrams, reports, recommendations, certificates, and of all other documents relating to the appointment of Mr. J. S. Jackson as superintendent of the Government shipyards at St. Joseph de Sorel. Presented January 22, 1914.—*Mr. Cardin*. *Not printed.*

70. Return to an Order of the House of the 29th January, 1913, for a copy of all letters, petitions, telegrams, complaints, reports, bonds of indemnity, and all other papers and documents in the possession of the Post Office Department, or any department of the Government, relating to the letting of a contract for carrying the mails between Sherbrooke, County of Guysborough, N.S., and Moser's River, County of Halifax, N.S., during the years 1911 and 1912. Presented January 22, 1914.—*Mr. Sinclair*.....*Not printed.*

70a. Return to an Order of the House of the 29th January, 1913, for a copy of all letters, and other documents relating to the mail contract between Scotsburn Station and West Branch, River John, County of Pictou, in the year 1912. Presented January 22, 1914. —*Mr. Macdonald*.....*Not printed.*

70b. Return to an Order of the House of the 2nd April, 1913, for a copy of all correspondence, reports and other documents relative to the mail contract between Scotsburn and West Branch, River John, Pictou County, since October 1, 1911. Presented January 22, 1914. —*Mr. Macdonald*.....*Not printed.*

70c. Return to an Order of the House of the 10th December, 1912, for a return showing (*a*) each mail contract awarded since the 15th of October, 1911; (*b*) the name of the tenderer in each case; (*c*) the figures of each tender; and (*d*) the name of each party to whom such contract has been awarded. Presented January 22, 1914.—*Mr. Lemieux*.....*Not printed.*

70d. Return to an Order of the House of the 15th January, 1913, for a return showing a list of the mail carriers whose contracts have been cancelled or renewed by the present Government in the County of Two Mountains, the names of such persons, the reasons for cancelling or renewing the said contracts, the former price and the present price of the said contracts; also a copy of all correspondence relating to the said mail carriers. Presented January 22, 1914.—*Mr. Ethier*.....*Not printed.*

70e. Return to an Order of the House of the 9th December, 1912, for a return showing all the mail contracts made between the Post Office Department of Canada and any party or parties, and cancelled before the maturity thereof from October 15, 1911, to the 15th of November, 1912, designating such cancelled mail contracts by giving the name of the contractor, the amount of the contract, the period of the unexpired service, the name of the district or districts, and the county and province wherein the service was performed, together with the reasons for such cancellation. Presented February 12, 1914. —*Mr. Maclean (Halifax)*.....*Not printed.*

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70*f*. Return to an Order of the House of the 29th January, 1913, for a copy of all papers, and documents of every nature and kind relating to a certain mail contract between Back Shore and Pictou, County of Pictou, since the death of the late contractor D. G. McKay, in 1912. Presented February 20, 1914.—*Mr. Macdonald*.....*Not printed.*

70*g*. Return to an Order of the House of the 14th April, 1913, for a copy of the contract between the Post Office Department and Napoleon Le Blanc, for the carrying of the mails between Carleton Centre and Carleton, Quebec, Railway Station, and of all correspondence, petitions, and other letters bearing on the cancelling of that contract and the awarding of a new one, with a copy of said new contract. Presented February 23, 1914.—*Mr. Marcil (Bonaventure)*.....*Not printed.*

70*h*. Return to an Order of the House of the 2nd April, 1913, for a copy of all papers relating to the mail contract from Noël to Walton, County of Hants, during the present year. Presented February 26, 1914.—*Mr. Macdonald*.....*Not printed.*

70*i*. Return to an Order of the House of the 12th May, 1913, for a copy of all tenders for, and correspondence relating to, the awarding of the contract for the carrying of His Majesty's mail between Warkworth and Colborne, County of Northumberland. Presented February 26, 1914.—*Mr. Graham*.....*Not printed.*

70*j*. Return to an Order of the House of the 12th May, 1913, for a copy of all correspondence, papers, &c., in connection with the carrying of the mail between St. François Xavier de Brompton and Windsor Mills, Quebec. Presented February 26, 1914.—*Mr. Tobin.* *Not printed.*

70*k*. Return to an Order of the House of the 17th February, 1913, for a return showing the number of mail contracts cancelled in the Province of Nova Scotia since October 10, 1911, the names of the contractors, the prices paid to them, the reason for the cancellation in each case, and a copy of any investigations and reports had into the causes of such cancellations, the names of the new contractors and the prices paid to them in each case. Presented March 2, 1914.—*Mr. Sinclair*.....*Not printed.*

70*l*. Return to an Order of the House of the 4th December, 1912, for a return showing the number of mail contracts cancelled in the County of Pictou since the 1st of October, 1911; the names of the contractors, the prices paid to them, the reason for the cancellation in each case; and a copy of any investigations and reports had into the causes of such cancellations, the names of the new contractors and the prices paid to them in each case. Presented March 2, 1914.—*Mr. Macdonald*.....*Not printed.*

70*m*. Return to an Order of the House of the 31st March, 1913, for a copy of all tenders received and of all letters, telegrams, papers and other documents relating to the mail contract between Tatamagouche and Brulé Shore, Colchester County, during the present year. Presented March 2, 1914.—*Mr. Macdonald*.....*Not printed.*

70*n*. Return to an Order of the House of the 9th December, 1912, for a copy of all letters, telegrams and correspondence referring to the tenders received and the contracts awarded, if any, for the carrying of the mails between Antigonish and Livingstone Cove. Presented March 5, 1914.—*Mr. Chisholm (Antigonish)*.....*Not printed.*

70*o*. Return to an Order of the House of the 19th May, 1913, for a copy of all telegrams and correspondence on file relating to the mail service between Antigonish and Livingstone Cove, and of the tenders received, and the contract entered into for this service. Presented March 12, 1914.—*Mr. Chisholm (Antigonish)*.....*Not printed.*

70*p*. Return to an Address to His Excellency the Administrator of the 28th April, 1913, for a copy of all documents, tenders, contracts, correspondence, orders in council, &c., in reference to the mail service between Bridgetown, Port Lorne and Hampton, Parker's Cove, Annapolis County, N.S., for which service tenders were recently solicited. Presented March 12, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

70*q*. Return to an Order of the House of the 9th February, 1914, for a copy of the advertisement for tenders, and of the tenders received, and of the contract awarded last year, for the carrying of the mails between Antigonish and Livingstone Cove, and of all letters, telegrams, correspondence and documents in any way relating thereto. Presented March 12, 1914.—*Mr. Chisholm (Antigonish)*.....*Not printed.*

70*r*. Return to an Order of the House of the 2nd February, 1914, for a return showing the names of all persons tendering, the amount of tender, and to whom awarded in 1913, for the carriage of mails covering the following mail routes in Shelburne County, Nova Scotia; Shelburne to Jordan Bay and Jordan Ferry and return; Clyde River to Upper Clyde and return; Lower Woods Harbour to Charlesville and return; Port Le Herbert to Sable River. Presented March 20, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

70*s*. Return to an Order of the House of the 9th February, 1914, for a copy of all tenders, contracts, documents, papers and correspondence in connection with tenders and contracts for the carriage of mails between Bridgetown and Port Lorne, Hampton and Parker's Cove, in 1912. Presented March 20, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

70*t*. Return to an Order of the House of the 9th February, 1914, for a copy of the contract entered into last year for the carrying of the mails between North Lochaber and Collegeville, and of all letters, telegrams, and correspondence referring to said service and the awarding of said contract. Presented March 23, 1914.—*Mr. Chisholm* (*Antigonish*). *Not printed.*

70*u*. Return to an Order of the House of the 9th February, 1914, for a copy of the advertisement for tenders, and of the tenders received last year for the carrying of the mails between Merigomish and Malignant Cove, and of all letters, telegrams and correspondence and documents in any way relating thereto. Presented March 25, 1914.—*Mr. Chisholm* (*Antigonish*).....*Not printed.*

70*v*. Return to an Order of the House of the 19th March, 1914, for a return showing how many mail contracts have been cancelled in the County of Inverness from September, 1911, up to date.

2. The route of each contract, the name of the contractor, and the amount of each contract.

3. The reasons for cancelling the several contracts. Presented April 22, 1914.—*Mr. Chisholm* (*Inverness*).....*Not printed.*

70*w*. Return to an Order of the House of the 30th March, 1914, for a copy of all letters, telegrams, correspondence, guarantee bonds, and other documents and security relating to the renewal of the contract with George A. Stewart for carrying mail between North Lochaber and West Lochaber, in or about the month of May, 1913, of the subsequent cancellation of said renewal contract, and of the contract made with Hugh D. Cameron for said service. Presented April 29, 1914.—*Mr. Chisholm* (*Antigonish*)..*Not printed.*

70*x*. Return to an Order of the House of the 4th March, 1914, for a copy of all correspondence, telegrams and papers generally concerning the increased railway mail subsidy recently agreed upon by the Postmaster General and the various railway companies. Presented April 30, 1914.—*Mr. Lemieux*.....*Not printed.*

70*y*. Return to an Order of the House of the 4th May, 1914, for a return showing the names of the 82 tenderers for the carrying of the mails between Baie St. Paul and Murray Bay, County of Charlevoix, and the amount of the tender in each case. Presented May 8, 1914.—*Mr. Lemieux*.....*Not printed.*

70*z*. Retun to an Order of the House of the 20th April, 1914, for a copy of all letters, papers, contracts, memoranda and other documents relative to the mail contract between Pictou post office and railway station, between the Post Office Department and Peter Foley. Presented May 8, 1914.—*Mr. Macdonald*.....*Not printed.*

70 (2*a*). Return to an Order of the House of the 23rd March, 1914, for a copy of all documents, letters, recommendations, &c., in connection with a contract awarded to Christophe Lavesque, of St. Eleuthère, for the conveyance of the mail between St. Eleuthère and Sully. Presented May 11, 1914.—*Mr. Lapointe* (*Kamouraska*).....*Not printed.*

70 (2*b*). Return to an Order of the House of the 11th May, 1914, for a return showing:—

1. Whether Mr. David Armstrong, mail carrier of the City of Sherbrooke, has been dismissed. If so, for what cause?

2. Whether an investigation was held at which he was given an opportunity of meeting his accusers and being heard in his own defence?

3. How many years Mr. Armstrong has been in the service?

4. What remuneration he was receiving for his services?

5. Whether a successor has been appointed? If so, what his name is, who recommended him and what remuneration he received. Presented May 28, 1914.—*Mr. McCrea*.....*Not printed.*

70 (2*c*). Return to an Order of the House of the 18th May, 1914, for a copy of all correspondence, papers, tenders and other documents in any way referring to the transfer from J. A. Campbell to Alexander Macdonnell of the contract for carrying the mail from Port Hood to South West Port Hood. Presented June 2, 1914.—*Mr. Chisholm* (*Inverness*).....*Not printed.*

70 (2*d*). Return to an Order of the House of the 17th February, 1913, for a return in duplicate showing the number of mail contracts cancelled in the Counties of Westmorland, Albert, Kings and Kent, Province of New Brunswick, since October 9, 1911, the names of the contractors, the prices paid to them, the reason for the cancellation in each case, and a copy of any investigations and reports had into the causes of such cancellations, the names of the new contractors, and the prices paid to them in each case; and in cases where tenders were asked and received preliminary to such new contracts, a statement in duplicate showing names of the tenderers, with the offers made by each, the name of the successful tenderer, and the amount or price for which contract was executed in each case; together with a copy in duplicate of all letters, correspondence and other communications relating to each such cancellation and the giving of any new contract. Presented June 2, 1914.—*Mr. Emmerson*.....*Not printed.*

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71. Return to an Order of the House of the 2nd June, 1913, for a copy of all correspondence and telegrams relating to complaints, political or otherwise, made against Mrs. Marcelline Roy, postmistress at Elm Tree, Gloucester County, N.B., which led the department to issue an order for an investigation, and the said postmistress to tender her resignation, and to the appointment of her successor. Presented January 22, 1914.—*Mr. Turgeon* ..... *Not printed.*

72. Return to an Order of the House, of the 26th March, 1913, for a copy of all petitions recommendations, correspondence, letters, telegrams and other communications concerning the change in location of the post office known as Masinasin, Province of Alberta. Presented January 22, 1914.—*Mr. Buchanan*..... *Not printed.*

73. Return to an Order of the House of the 31st March, 1913, for a copy of all letters, telegrams and petitions concerning the closing of the Moulin Basinet post office, Parish of St. Jean de Matha, County of Joliette. Presented January 22, 1914.—*Mr. Lemieux.* *Not printed.*

74. Return to an Order of the House of the 7th April, 1913, for the production of one sample of a patented lock and key sold by the Ontario Equipment Company of Ottawa to the Post Office Department. Presented January 22, 1914.—*Mr. Verville*..... *Not printed.*

74*a*. Return to an Order of the House of the 2nd April, 1913, for a copy of all correspondence between the Post Office Department and Alleyn Taschereau, advocate of Quebec, concerning the purchase of new locks for the mail bags. Presented January 22, 1914.—*Mr. Carvell* ..... *Not printed.*

74*b*. Return to an Order of the House of the 4th March, 1914, for a copy of the application, correspondence and papers generally concerning mail lock patent No. 151043. Presented May 11, 1914.—*Mr. Lemieux*..... *Not printed.*

75. Return to an Order of the House of the 10th February, 1913, for a copy of all letters, telegrams and other correspondence exchanged between the Post Office Department and Messrs. A. de Macdonald, Elzear Monpetit and all others, relating to the change of the postmasters at Ile Perrot North and Ile Perrot South, Vaudreuil Station, Roquebrune, St. Lazare Village, Mount Oscar and Pte. Fortune, and of the report of the inquiring commissioner in each of the cases in which an inquiry was held; of the correspondence exchanged between the parties above named relative to the new post office building at Rigaud and of correspondence exchanged between the parties above mentioned, relating to the post offices lately named Choisy and Demartigny. Presented January 22, 1914.—*Mr. Boyer* ..... *Not printed.*

75*a*. Return to an Order of the House of the 9th April, 1913, for a copy of all documents bearing on changes asked for in the postmastership of Port Daniel Centre, Avignon, New Richmond and Black Cape, Bonaventure County; and of all documents bearing on the closing of Black Cape East post office, Bonaventure County. Presented January 22, 1914.—*Mr. Marcil* ..... *Not printed.*

75*b*. Return to an Order of the House of the 2nd February, 1914, for a copy of all letters, telegrams, papers, and other documents connected with the removal of the post office from the store of Alexander Robertson at Red Point, P.E.I., to the store of J. E. Robertson of the same place. Presented February 20, 1914.—*Mr. Hughes (P.E.I.)*..*Not printed.*

75*c*. Return to an Order of the House of the 16th February, 1914, for a copy of any complaints made against John A. Campbell, postmaster of New Richmond, Quebec, and of all correspondence bearing on any change called for in that office. Presented March 17, 1914.—*Mr. Marcil (Bonaventure)*..... *Not printed.*

76. Return to an Order of the House of the 7th May, 1913, for a copy of all correspondence and telegrams exchanged between the Post Office Department, the Government or any member thereof, the post office inspector at St. John, N.B., or any official of the Post Office Department at St. John, N.B., on the one hand, and the postmaster at Kouchibouguac, Kent County, N.B., Mr. Cliff Atkinson, or any other person, corporation or firms, relating to the sale or non-purchase of postage stamps, or the mailing of letters, delivery of mail, &c., at the said post office; together with a copy of all correspondence, reports and other papers and documents in any wise relating thereto, on file in the Post Office Department at Ottawa, or in the office of the post office inspector at St. John, N.B.; also a copy of all regulations or orders of the Post Office Department relating to the sale of postage stamps, or the mailing of letters, or the delivery of mails, or generally as to the use of post office by residents and non-residents. Presented January 22, 1914.—*Mr. Emmerson* ..... *Not printed.*

77. Return to an Order of the House of the 2nd June, 1913, for a return showing the names, dates of appointment and salary respectively, of the employees of the Moosejaw post office. Presented January 22, 1914.—*Mr. Knowles*..... *Not printed.*

77*a*. Return to an Order of the House of the 24th February, 1913, for a copy of all letters, telegrams, recommendations, petitions and documents, relating to the appointment of Mr. Pierre Cournoyer as postmaster at St. Pierre de Sorel, County of Richelieu. Presented January 22, 1914.—*Mr. Cardin*..... *Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

77*b*. Return to an Order of the House of the 14th April, 1913, for a return showing what public officers have been appointed in the City of Qubeec, in the Departments of Inland Revenue, Post Office, Railways and the Transcontinental, Customs, Immigration, Marine and Fisheries, Public Works and Militia, since the 1st October, 1911, up to this date; together with the names and duties of these persons, the dates of their appointment, the salary paid in each case and the increases granted since; also the date of these increases, and which ones of these officers have passed the Civil Service examinations required for the positions which they occupy, and on what dates they passed such examinations; and also a copy of all correspondence, requests, recommendations and reports relating to the appointment of these officers. Presented January 22, 1914.—*Mr. Lachance.*
Not printed.

77*c*. Return to an Order of the House of the 29th January, 1913, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Department of Railways and Canals, or of the Intercolonial Railway, or of the Government Railways Managing Board, relating or in any manner appertaining to the appointment and employment of train or ticket agents on the Intercolonial Railway and Prince Edward Island Railway, together with a copy of all statements showing the amounts received by said agent, in cash and tickets, on the trains of the respective divisions of said railways; and also showing the amounts received during corresponding periods for the past two years, in cash and tickets, on the same trains on the said respective divisions by the conductors of said trains, when no train or ticket agents were employed thereon, either before or since the employment of such agents on the respective trains and also a copy of all statements showing the results of the experiment in employing such ticket agents. Presented January 22, 1914.—*Mr. Emmerson* ..... *Not printed.*

77*d*. Partial Return to an Order of the House of the 9th December, 1912, for a return showing when Mr. J. G. H. Bergeron was appointed commissioner to hold investigations, the number of investigations held since his appointment, salary received in each case and the amount paid for travelling expenses in each case. Presented January 22, 1914.—*Mr. Lemieux* ..... *Not printed.*

77*e*. Return to an Address to His Royal Highness the Governor General of the 29th January, 1913, for a copy of all orders in council, memoranda or instructions issued to or written to H. P. Duchemin in connection with his appointment as a commissioner to conduct investigations regarding political partisanship in the Province of Nova Scotia; also a copy of all letters received by any department of the Government from the said H. P. Duchemin relating to such investigations since the date of his appointment as such commissioner, and all instructions of whatever nature at any time issued to him relating to such investigations. Presented January 22, 1914.—*Mr. Lemieux*.... *Not printed.*

77*f*. Appointment of F. Roy, as postmaster of St. Phillipe de Nery, &c., Province of Quebec. Presented January 22, 1914.—*Mr. Lapointe (Kamouraska)*..... *Not printed.*

77*g*. Supplementary Return to an Order of the House of the 9th December, 1912, for a return showing when Mr. J. G. H. Bergeron was appointed commissioner to hold investigations, the number of investigations held since his appointment, salary received in each case and the amount paid for travelling expenses in each case. Presented February 23, 1914. —*Mr. Lemieux* ..... *Not printed.*

77*h*. Return to an Order of the House of the 9th February, 1914, for a copy of all correspondence, telegrams, and other documents, relating to the removal of T. J. Oliver, as Dominion Lands Agent at Humboldt, Saskatchewan, his appointment to his present position, and the appointment of his successor at Humboldt. Presented March 6, 1914.—*Mr. Neely* ..... *Not printed.*

77*i*. Return to an Order of the House of the 9th February, 1914, for a copy of all correspondence, telegrams, letters of instructions, or other documents relating to the removal of W. S. McKechnie, as Dominion Lands Agent at Prince Albert, Saskatchewan, and the appointment of his successor. Presented March 6, 1914.—*Mr. Neely*..... *Not printed.*

77*j*. Return to an Order of the House of the 2nd February, 1914, for a copy of all correspondence, telegrams and papers generally in connection with the appointment of Joseph Lemieux as postmaster at Mont Louis, County of Gaspé. Presented March 6, 1914.—*Mr. Lemieux* ..... *Not printed.*

77*k*. Return to an Order of the House of the 7th April, 1913, for a copy of all correspondence, telegrams, petitions, affidavits, complaints, certificates, recommendations, reports and other documents relating to the engagement and appointment for the year 1913, of the captains and first and second engineers for dredging machines Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11 of the Department of Marine and Fisheries, under the control of the agency at Sorel, and employed in the deepening of the St. Lawrence below Montreal. Return to an Order of the House of the 7th April, 1913, for a copy of all correspondence, telegrams, petitions, affidavits, complaints, certificates, recommendations, reports and other documents, relating to the engagement and appointment of the captains and engineers for the year 1913, for the tugs *Carmelia, Chambly, Contrecoeur ,De Lévis, Emilia, Iberville, James Howden, Jesse Hume, Lac St. Pierre, Lanoraie, Lotbinière, Portneuf, Varennes and Vercheres,* of the Department of Marine and Fisheries under the control of the agency at Sorel. Presented March 23, 1914.—*Mr. Cardin*..... *Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

77*l*. Return to an Order of the House of the 23rd March, 1914, for a return showing:—
1. How many additional employees have been added to the Customs Department in the City of Halifax, since October 10, 1911.
2. Their names and salaries at the time of their appointment, their respective salaries at present, and also their respective ages at the time of appointment.
3. Whether all of them passed the necessary Civil Service examinations for the Customs service.
4. How many temporary clerks there are upon the said Customs staff, who they are, and the dates of their appointment. Presented April 2, 1914.—*Mr. Maclean (Halifax)* ..... *Not printed.*

77*m*. Return to an Order of the House of the 28th April, 1913, for a copy of all letters and telegrams exchanged between the Government and Messrs. Arch. Macdonald, Elz. Monpetit and others, on the subject of the appointment of caretakers of the post office at Rigaud, Messrs. Jean Baptiste Charlebois and Napoleon Vallée. Presented April 2, 1914.—*Mr. Boyer* ..... *Not printed.*

77*n*. Return to an Order of the House of the 23rd February, 1914, for a copy of all correspondence, recommendations, &c., relating to the appointment of Allan Morrison, St. Peter's, N.S., as inspector of dwellings erected on Gregory Island, Richmond County, N.S., in 1912-1913, and of all accounts, charges, vouchers, &c., rendered to the Department of Marine and Fisheries by the said Allan Morrison as such inspector. Presented April 7, 1914.—*Mr. Kyte* ..... *Not printed.*

77*o*. Return to an Order of the House of the 9th February, 1914, for a return showing the names, date of appointment, length of service, remuneration and office held by each of all the employees of the Department of the Interior in the outside service since January 1, 1912, to December 31, 1913, not given in the Civil Service list of 1912 or 1913. Presented April 21, 1914.—*Mr. Neely*..... *Not printed.*

77*p*. Return to an Order of the House of the 16th April, 1914, for a return showing:—
1. How many appointments have been made in the Customs Department at Montreal since the 1st of October, 1911.
2. The names of the persons so appointed, and the dates of their respective appointments.
3. After what recommendations have they been appointed.
4. The salary of each of these new employees.
5. What increases of salaries have been granted in the same department since the same date, and to whom, and why. Presented April 29, 1914.—*Mr. Proulx.*
Not printed.

77*q*. Return to an Order of the House of the 2nd February, 1914, for a return showing the number of engineers, assistant engineers, draftsmen, clerks, divers, and students in engineering or surveying, or other parties employed by the Department of Public Works in the constituency of Bonaventure, from October 11, 1911, to date, with their names, residences, salaries, nature of their work, time employed, and on whose recommendation, together with a copy of all correspondence, and reports bearing on such employment, and of reports made to the said Department of Public Works in that constituency from January, 1913, to date. Presented April 30, 1914.—*Mr. Marcil (Bonaventure).*
Not printed.

77*r*. Return to an Order of the House of the 12th March, 1914, for a return showing:—
1. Whether Louis Philippe Thibault, Alphonse Poirier, J. A. Morin, C. F. Rioux, Thomas Thibault and Adjutor Demers, of Lévis, have been appointed to positions under the control of the Postmaster General of Canada.
2. If so, to what positions they have been appointed, what their duties are, when they were appointed and their salaries, respectively.
3. The names of the officers who have been dismissed and replaced by the above.
4. The total amount of the annual salaries of said dismissed officers. Presented May 4, 1914.—*Mr. Bourassa*..... *Not printed.*

77*s*. Return to an Order of the House of the 16th March, 1914, for a copy of all recommendations, protests, petitions, and representations received by the Government or any Department or Minister thereof, regarling the appointment of the present collector of customs at Antigonish, and of all the letters, telegrams and correspondence relating thereto. Presented May 15, 1914.—*Mr. Chisholm (Inverness)*..... *Not printed.*

77*t*. Return to an Order of the House of the 16th March, 1914, for a copy of all recommendations, protests, petitions, and representations received by the Governmest or any Department or Minister thereof, regarding the appointment of the present collector of customs at Antigonish, and of all the letters, telegrams and correspondence relating thereto. Presented May 16, 1914.—*Mr. Chisholm (Antigonish)*..... *Not printed.*

77*u*. Return to an Order of the House of the 16th February, 1914, for a copy of all papers in connection with the employment of Arthur Dubisson as immigration agent at Gravelburg, Sask., and all papers in connection with the said Dubisson, showing the moneys paid to him and the work performed by him. Presented May 30, 1914.—*Mr. Knowles.*
Not printed.

CONTENTS OF VOLUME 28—*Continued.*

78. Return to an Order of the House of the 7th April, 1913, for a copy of all documents, recommendations and correspondence relating to the resignation of C. A. R. Desjardins, as postmaster at St. Andre de Kamouraska, and the appointment of his successor. Presented January 22, 1914.—*Mr. Lapointe (Kamouraska)* ..... *Not printed.*

78a. Return to an Order of the House of the 28th April, 1913, for a copy of all complaints or charges against Fred. R. Irish, postmaster at Afton, Antigonish County, N.S., and of all correspondence on file in reference thereto. Presented January 22, 1914.—*Mr. Chisholm (Antigonish)* ..... *Not printed.*

79. Return to an Order of the House of the 29th January, 1913, for a copy of all correspondence, papers, &c., concerning the application made by the Long Sault Development Company, with a view to dam the St. Lawrence river above the Long Sault rapids from the American to the Canadian side. Presented January 22, 1914.—*Mr. Lemieux.*
Not printed.

79a. Supplementary Return to an Order of the House of the 29th January, 1913, for a copy of all correspondence, papers, &c., concerning the application made by the Long Sault Development Company, with a view to dam the St. Lawrence river above the Long Sault rapids from the American to the Canadian side. Presented February 12, 1914.—*Mr. Lemieux* ..... *Not printed.*

80. Return to an Order of the House of the 21st April, 1913, for a return showing all leases of water powers granted on the Winnipeg river, the dates of such leases, to whom granted, and the location of the water powers covered by each; together with a copy of all correspondence passing between the Government, or any member thereof and any person or persons, with respect to such leases. Presented January 22, 1914.—*Mr. Martin (Regina)* ..... *Not printed.*

80a. Return to an Order of the House of the 2nd April, 1913, for a return showing whether the Government cancelled any water lot leases on the Lachine Canal and, if so, the dates of such cancellation; the names of the lessees; length of time the cancelled leases were in force, and the rental paid in each case; the names of the lessees whose water lot leases on the said canal have not been cancelled, and the rental paid by each; the basis on which rental has been calculated and the method to be followed in future; the reasons why some leases were cancelled and others allowed to remain in force; and if tenders are to be invited through the press for such water lot leases in future. Presented January 22, 1914.—*Mr. Buchanan* ..... *Not printed.*

80b. Return to an Order of the House of the 23rd April, 1913, for a return showing all leases or permits granted to clubs or individuals to erect or maintain boat houses on the Rideau canal between Laurier avenue bridge and Hartwells Locks, the date of such leases or permits, to whom granted, and the rental in each case; together with a copy of all correspondence between the Government, or any member thereof, and any person or persons with respect to such leases or permits and the cancellation thereof. Presented January 22, 1914.—*Mr. Murphy* ..... *Not printed.*

80c. Supplementary Return to an Order of the House of the 2nd April, 1913, for a return showing whether the Government cancelled any water lot leases on the Lachine canal and, if so, the date of such cancellation; the names of the lessees; length of time the cancelled leases were in force, and the rental paid in each case; the names of the lessees whose water lot leases on the said canal have not been cancelled, and the rental paid by each; the basis on which rental has been calculated and the method to be followed in future; the reasons why some leases were cancelled and others allowed to remain in force; and if tenders are to be invited through the press for such water lot leases in future. Presented March 13, 1914.—*Mr. Buchanan* ..... *Not printed.*

80d. Return to an Order of the House of the 23rd March, 1914, for a copy of the agreement for a lease of water power on the Saskatchewan river at Rocky Rapids, Alberta, made with the Edmonton Power Company, with information in detail as to the operations carried on by the company to date. Presented April 21, 1914.—*Mr. Oliver* ..... *Not printed.*

81. Return to an Order of the House of the 28th April, 1913, for a return showing a list of all the newspapers in Canada in which advertisements have been inserted by the Government, or any minister, officer or department thereof, between October 10, 1911, and the present date, together with a statement of the gross amount paid therefor between the above dates to each of said newspapers or to the proprietors of the same. Presented January 22, 1914.—*Mr. Sinclair* ..... *Not printed.*

81a. Partial Return to an Order of the House of the 30th April, 1913, for a return showing a list of all newspapers in Canada in which advertisements have been inserted by the Government, or any minister, officer or department thereof, between the 10th day of October, 1906, and 10th October, 1907, and between said dates in each of the years following up to the 10th of October, 1911, together with a statement of the gross amount paid therefor for the years mentioned, to each of the said newspapers or the proprietors of the same. Presented January 22, 1914.—*Mr. Thornton* ..... *Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

81*b*. Supplementary Return to an Order of the House of the 30th April, 1913, for a return showing a list of all the newspapers in Canada in which advertisements have been inserted by the Government, or any minister, officer or department thereof, between the 10th day of October, 1906, and 10th October, 1907, and between said dates in each of the years following up to the 10th of October, 1911, together with a statement of the gross amount paid therefor for the years mentioned, to each of the said newspapers or the proprietors of the same. Presented April 1, 1914.—*Mr. Thornton*.....*Not printed.*

81*c*. Further Supplementary Return to an Order of the House of the 28th April, 1913, for a return showing a list of all the newspapers in Canada in which advertisements have been inserted by the Government, or any minister, officer or department thereof, between Octoper 10, 1911, and the present date, together with a statement of the gross amount paid therefor between the above dates to each of said newspapers or to the proprietors of the same. Presented April 2, 1914.—*Mr. Sinclair*.....*Not printed.*

81*d*. Supplementary Return to an Order of the House of the 30th April, 1913, for a Return showing a list of all the newspapers in Canada in which advertisements have been inserted by the Government, or any minister, officer or department thereof, between the 10th day of October, 1906, and 10th October, 1907, and between said dates in each of the years following up to the 10th of October, 1911; together with a statement of the gross amount paid therefor for the years mentioned, to each of the said newspapers or the proprietors of the same. Presented April 2, 1914.—*Mr. Thornton*....*Not printed.*

81*e*. Return to an Order of the House of the 15th April, 1914, for a return showing how much money has been paid by the Government, or any department thereof, since October 10, 1911, to the Herald Publishing Company of Halifax, N.S., for advertising, printing and lithographing. Presented April 27, 1914.—*Mr. Sinclair*.....*Not printed.*

81*f*. Return to an Order of the House of the 4th February, 1914, for a return showing the names of all printing and publishing companies, and newspapers in Nova Scotia to whom any sum of money has been paid respectively, by any department of Government, during the calendar years 1912 and 1913 respectively, and the nature of the service rendered therefor. Presented April 29, 1914.—*Mr. Maclean (Halifax)*....*Not printed.*

81*g*. Supplementary Return to an Order of the House of the 28th April, 1913, for a return showing a list of all the newspapers in Canada in which advertisements have been inserted by the Government, or any minister, officer or department thereof, between October 10, 1911, and the present date, together with a statement of the gross amount paid therefor between the above dates to each of said newspapers or to the proprietors of the same. Presented May 11, 1914.—*Mr. Sinclair*.....*Not printed.*

82. Return to an Order of the House of the 3rd February, 1913, for a copy of all letters, correspondence, reports and other documents in the possession of the Department of Railways and Canals relating to an application by the Central Railway Company of Canada to the Honourable Minister of Railways and Canals for the approval of their proposed route between Hawkesbury and South Indian. Presented January 22, 1914.—*Mr. Proulx* .....*Not printed.*

83. Return to an Order of the House of the 9th December, 1912, for a copy of all documents, papers, memoranda, rulings, findings, appeals and correspondence relating to any appeal asserted from any decision, ruling or finding of the Board of Railway Commissioners of Canada to the Privy Council of Canada, and the action taken by the Privy Council thereon. Presented January 22, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

84. Return to an Order of the House of the 7th May, 1913, for a return showing the total cost of the Elmira Branch Railway in Prince Edward Island; the total amounts paid the contractors, Whitehead Brothers; the total amount paid by the Government after taking the work off the contractor's hands, and showing the amount paid in wages each month, the names of the men to whom it was paid, the positions they held, and the wages per day to each; also showing what materials were used, each kind and class, with the cost of each, from whom purchased, and when, and the quantities left over, if any. Presented January 22, 1914.—*Mr. Hughes (P.E.I.)*.....*Not printed.*

85. Return to an Order of the House of the 15th January, 1913, for a copy of all letters, telegrams, correspondence and documents referring in any way to the claim of the municipalities of Pictou, Antigonish, Guysboro and St. Mary's for payment or refund to them of the monies paid by said municipalities for the right of way of that part of the Intercolonial Railway running through the Counties of Pictou, Antigonish and Guysboro. Presented January 22, 1914.—*Mr. Chisholm (Antigonish)*.....*Not printed.*

85*a*. Return to an Order of the House of the 12th May, 1913, for a copy of all claims made by H. F. McDougall, of Grand Narrows, N.S., against the Intercolonial Railway, and of all letters, telegrams and other documents in connection with the said claim or claims; together with the particulars of said claims; the amount or amounts paid upon said claim or claims; the particular items of the claim or claims upon which payments, if any, were made; the date of the filing of the claims and of the payment or payments made thereon; and the total amount paid on said claims or upon any other claims made by the said H. F. McDougall against the said Intercolonial Railway or the Government of Canada. Presented January 22, 1914.—*Mr. Sinclair*.....*Not printed.*

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85*b*. Return to an Order of the House of the 16th February, 1914, for a copy of all documents, letters, petitions, telegrams and evidence heard, reports, &c., in connection with the claims of Eugene Demers and Joseph Olivier, of the parish of St. Nicholas, County of Lévis, for damages arising out of fires caused by the Intercolonial Railway's locomotives; and, if investigations have been held, a copy of all evidence and documents relating thereto. Presented March 6, 1914.—*Mr. Bourassa*.....*Not printed.*

85*c*. Return to an Order of the House of the 27th April, 1914, for a copy of all letters, telegrams, reports, correspondence and documents relative to the claims made for damages from a fire in the village of Hopewell, County of Pictou, which was occasioned by sparks from a locomotive on the Intercolnial Railway. Presented May 13, 1914.—*Mr. Macdonald* .....*Not printed.*

86. Return to an Order of the House of the 14th May, 1913, for a copy of all reports, correspondence and other documents on file in the Department of Raiwlays and Canals, relating in any way to a suggested survey and construction of a line of railways from Country Harbour, Guysborough County, N.S., to Cape George, N.S., or any other point in Antigonish County. Presented January 22, 1914.—*Mr. Chisholm (Antigonish).*
Not printed.

86*a*. Return to an Order of the House of the 29th January, 1912, for a copy of all letters, written to the Right Honourable the Prime Minister, the Honourable the Minister of Railways and Canals, or any other member of the Government since October 10, 1911, by S. R. Griffin, Goldboro, N.S., John S. Wells, White Head, N.S., and G. A. R. Rowlings, Sydney, N.S., relating to the construction of a branch line of the Intercolonial Railway into the County of Guysboro, N.S., also of the replies to the same. Presented January 22, 1914.—*Mr. Sinclair*.....*Not printed.*

87. Return to an Order of the House of the 27th January, 1913, for a copy of the contract entered into by C. R. Scoles, New Carlisle, Quebec, with the Department of Railways and Canals for the completion of the Atlantic and Lake Superior Railway between Caplin and Paspebiac, and of the report of the engineers on such work, of details of payments, and of all documents bearing on such matter. Presented January 22, 1914. —*Mr. Marcil* .....*Not printed.*

88. Return to an Order of the House of the 21st May, 1913, for a copy of all documents, correspondence, reports and inquiries, relating to an accident which occurred at Trois Pistoles, Intercolonial Railway on 10th September, 1912, respecting the death of Arsène Ouellet, and the wounds inflicted on Joseph Gagnon, at the time that these two men were struck by train No. 150 on the above date. Presented January 22, 1914.—*Mr. Boulay* .....*Not printed.*

89. Annual Return respecting Trade Unions under Chapter 125, R.S.C., 1906. Presented by Hon. Mr. Coderre, January 22, 1914.....*Not printed.*

90. Return to an Order of the House of the 29th January, 1913, for a return showing:—

1. What purchases of land have been made by the Dominion of Canada since Confederation?
2. The amount of money paid for same?
3. The approximate area of land so purchased?
4. In what provinces the said land is now situated?
5. The approximate area in each province?
6. The acreage of school lands set aside by the Government for the Provinces of Manitoba, Saskatchewan and Alberta?
7. The present approximate value of the said school lands so set aside in each of the said Provinces?
8. The number of acres of the said school lands already sold in each of the said Provinces, and the proceeds of such sales, deducting expenses?
9. The acreage of lands set apart at any time by the Government as an endowment to any university, the name of the university, and the Province in which the lands are situated?
10. The number of acres of swamp lands transferred to the Province of Manitoba under the provisions of Chapter 50 of the Acts if 1885 and amendments thereto?
11. The gross amount of cash allowance made at any time by the Federal Government to each or any Province of Canada, to assist in the construction of necessary public buildings?
12. The approximate value of the railway, public works and other assets of each of the Provinces of Canada, taken over by the Federal Government at the time that each Province entered the union?
13. The annual compensation made to the Province of Manitoba, Saskatchewan and Alberta, by reason of the fact that they are deprived of the public lands as a source of revenue?
14. The debt allowance to any time placed to the credit of each of the Provinces of Canada by the Federal Government. Presented January 22, 1914.—*Mr. Sinclair.*
Not printed.

CONTENTS OF VOLUME 28—*Continued.*

90a. Supplementary Return to an Order of the House of the 29th January, 1913, for a return showing:—

1. What purchases of land have been made by the Dominion of Canada since Confederation?
2. The amount of money paid for same?
3. The approximate area of land so purchased?
4. In what Provinces the said land is now situated?
5. The approximate area in each Province?
6. The acreage of school lands set aside by the Government for the Provinces of Manitoba, Saskatchewan and Alberta?
7. The present approximate value of the said school lands so set aside in each of the said Provinces?
8. The number of acres of the said school lands already sold in each of the said Provinces, and the vroceeds of such sales, deducting expenses.
9. The acreage of lands set apart at any time by the Government as an endowment to any university, the name of the university, and the Province in which the lands are situated?
10. The number of acres of swamp lands transferred to the Province of Manitoba under the provisions of Chapter 50 of the Acts of 1885 and amendments thereto?
11. The gross amount of cash allowance made at any time by the Federal Government to each or any Province of Canada, to assist in the construction of necessary public buildings?
12. The approximate value of the railway, public works and other assets of each of the Provinces of Canada, taken over by the Federal Government at the time that each Province entered the union?
13. The annual compensation made to the Provinces of Manitoba, Saskatchewan and Alberta, by reason of the fact that they are deprived of the public lands as a source of revenue?
14. The debt allowance to any time placed to the crédit of each of the Provinces of Canada by the Federal Government. Presented March 12, 1914.—*Mr. Sinclair.*
Not printed.

91. Partial Return to an Order of the House of the 12th May, 1913, for a return showing the names and purposes of the several Commissions created by legislation or Orders in Council since October 12, 1911; the names of the members of the several commissioners, with their respective salaries and remuneration; the names of commissions still in existence; and the names of commissions created since October 12, 1911, which have ceased to exist. Presented January 22, 1914.—*Mr. Oliver*.....*Not printed.*

91a. Partial Return to an Address to His Royal Highness the Governor General of the 4th December, 1912, for a copy of each Commission issued by the Government since October 10, 1911, directing an investigation to be held; and also for a copy of the evidence taken and the report made in each case that has been concluded. Presented January 22, 1914.—*Mr. Murphy* .....*Not printed.*

91b. Further Supplementary Return to an Address to His Royal Highness the Governor General of the 4th December, 1912, for a copy of each Commission issued by the Government since October 10, 1911, directing an investigation to be held; and also for a copy of the evidence taken and the report made in each case that has been concluded. Presented February 9, 1914.—*Mr. Murphy*.....*Not printed.*

91c Return to an Order of the House of the 9th December, 1912, for a return showing the number of Commissions formed by the Government since September 21, 1912, the names and the occupations of the Commissioners appointed, their duties, the duration of their services, and their remuneration. Presented February 12, 1914.—*Mr. Devlin.*
Not printed.

91d. Return to an Address to His Royal Highness the Governor General of the 9th February, 1914, for a copy of the Order in Council appointing a Commission for the purpose of beautifying the city of Ottawa and vicintiy, of all correspondence with regard to the same, and of all reports made by the commission up to date. Presented March 6 1914. —*Sir W. Laurier* .....*Not printed.*

91e. Supplementary Return to an Order of the House of the 12th May, 1913, for a return showing the names and purposes of the several Commissions created by legislation or Orders in Council since October 12, 1911; the names of the members of the several commissioners, with their respective salaries and remuneration; the names of commissions still in existence; and the names of commissions created since October 12, 1911, which have ceased to exist. Presented March 9, 1914.—*Mr. Oliver*.....*Not printed.*

91f. Return to an Order of the House of the 9th February, 1914, for a return showing the number and particulars of Commissions authorized or issued under the Inquiries Act since October 1, 1911, the purpose or object thereof, the name of the Commissioner or Commissioners, and the cost of each to the present time. Presented May 29, 1914.—*Mr. Maclean (Halifax)* .....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

92. Partial Return to an Order of the House of the 28th April, 1913, for a return showing all those who have been holding investigations within the judicial district of Three Rivers, since October 15, 1911, to date, in reference to the conduct of men holding offices from the Dominion Government, the place where each investigation was held, the amount paid to each investigator in each case; the names of the solicitors employed in each case, the post office addresses, and the amount paid in each case to the solicitor. Presented January 22, 1914.—*Mr. Bureau*.....*Not printed.*

93. Return to an Order of the House of the 26th March, 1913, for a return showing whether the Government paid or intends to pay fees and disbursements of the witnesses summoned by the commissioners appointed by it in the County of Lévis, to hold inquiries on the conduct of public officers whose dismissal had been requested; the amounts which have been paid and to whom, and the sum remaining to be paid for the same purpose. Presented January 23, 1914.—*Mr. Bourassa*.....*Not printed.*

93*a*. Partial Return to an Order of the House of the 4th June, 1913, for a return showing the total expenditure to date by the present administration in connection with the investigation of charged partisan conduct against officials. Presented January 23, 1914.—*Mr. Sinclair* .....*Not printed.*

93*b*. Partial Return to an Order of the House of the 7th May, 1913, for a return showing in deaail the names of witnesses summoned by Commissioner H. P. Duchemin in connection with all investigations held by him in the counties of North Cape Breton and Victoria, South Cape Breton, Inverness and Antigonish, Nova Scotia, and the amounts paid in each such case. Presented January 23, 1914.—*Mr. Carroll*.....*Not printed.*

93*c*. Return to an Order of the House of the 9th April, 1913, for a return showing in detail the expenditure incurred since October 11, 1911, in connection with investigations held in Bonaventure County by commissioners appointed by the Departments of the Post Office, Customs, and Marine and Fisheries into charges made against employees of said departments of offensive political partisanship, together with the names and amounts paid to each of said commissioners in each investigation, as well as details of amounts paid to witnesses and others. Presented January 23, 1914.—*Mr. Marcil*.....*Not printed.*

93*d*. Return to an Order of the House of the 26th February, 1913, for a copy of all statements of account for salary or remuneration to the commissioner, and his expenses for witness fees, and all other expenses in connectoin with the investigation by Commissioner Duchemin, of the following, persons in the Ciunty of Guysboro, Nova Scotia namely:—

H. L. Tory, fishery officer, Guysboro.
John W. Davis, fishery officer, Guysboro.
Patrick Shea, postmaster, Tompkinsville.
John M. Rogers, postmaster, East Roman Valley.
James Bowles, postmaster, Alder River.
Abner M. Carr, postmaster, St. François Harbour.
Everett Hadley, postmaster, Oyster Ponds.
Parker S. Hart, postmaster, Lower Manchester.
S. M. Ferguson, preventive officer, Oyster Pond.
Robert Hendsbee, postmaster, Half Island Cove.
A. B. Cox, Manager Reduction Works, Canso.
Edward Kelly, engineer, Reduction Works, Canso.
D. S. Hendsbee, weigher, Reduction Works, Canso.
Alex. Roberts, postmaster, Canso.
David Sutherland, caretaker, Canso.
Henry Hanlon, chief engineer, Hatchery, Canso.
Thos. Sullivan, assistant engineer, Canso.
W. G. Matthew, cockswain life-boat, Canso.
Patrick Ryan, assistant cockswain life-boat, Canso.
M. McCutcheon, postmaster, Sonora.
Stanley McCutcheon, preventive officer, Sonora.
Freeman Pride, lightkeeper, Sonora.
David Reid, fishery officer, Port Hilford.
L. M. Pye, customs officer, Liscomb.
Stanley Hemlow, lightkeeper, Liscomb.
W. H. Hemlow, keeper storm drum, Liscomb.
R. Conroy, postmaster, Country Harbour.
John Milward, postmaster, Stormont.
A. W. Salsman, postmaster, Lower Country Harbour.
W. B. Harris, postmaster, Whitehead.
E. L. Munro, customs officer, Whitehead.
W. L. Munro, lightkeeper, Whitehead.
Patrick Conway, lightkeeper, Whitehead
H. P. Munro, cockswain life-boat, Whitehead.
Levi Munro, harbour master, Whitehead.
William McKinnon, postmaster, Erinville.

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J. H. McMillan, manager hatchery, Isaac's Harbour.
Sanford Langley, postmaster, Isaac's Harbour North.
Fred. E. Cox, engineer lobster hatchery, Isaac's Harbour.
Simon Hodgson, assistant engineer, Isaac's Harbour.
Archibald Brass, postmaster, L. New Harbour.
Parker Sangster, postmaster, New Harbour West.
William Gerrior, customs officer, Larry's River.
James M. Webber, lightkeeper, Torbay Point.
W. A. Hattie, preventive officer, Mulgrave.
J. F. Reeves, postmaster, Mulgrave.
John P. Meagher, foreman deck-hand, Mulgrave.
Philip H. Ryan, Intercolonial Railway employee, Mulgrave.
Alex. Wilkinson, Intercolonial Railway employee, Mulgrave.
Alex. McInnis, car inspector, Mulgrave.
Frank Fougere, postmaster, Port Felix.
Sam. Smith, postmaster, Port Felix, West.
Captain Freeman Myers, postmaster, Cole Harbour.
George Taylor, postmaster, Beckerton.
Stephen C. Richard, lightkeeper, Charlo's Cove. Presented January 26, 1914.—*Mr. Sinclair* ..... *Not printed.*

93*e*. Supplementary Return to an Order of the House of the 7th May, 1913, for a return showing in detail the names of witnesses summoned by Commissioner H P. Duchemin in connection with all investigations held by him in the Counties of North Cape Breton and Victoria, South Cape Breton, Inverness and Antigonish, Nova Scotia, and the amounts paid in each such case. Presented February 10, 1914.—*Mr. Carroll*.....*Not printed.*

93*f*. Return to an Order of the House of the 9th December, 1912, for a return showing when H. P. Duchemin, of Sydney, Nova Scotia, was appointed commissioner to hold investigations, the number of investigations held since his appointment, names of officials investigated, if evidence and report in each investigation has been forwarded by Mr. Duchemin to the department interested, if not, in what cases has no evidence and report been submitted, salary or remuneration received in each case, and amount paid for travelling expenses in each case. Presented February 10, 1914.—*Mr. Carroll.*
Not printed.

93*g*. Return to an Order of the House of the 23rd February, 1914, for a return showing the expenditures by the Intercolonial Railway in connection with all the inquiries and investigations held by H. P. Duchemin, concerning any and all employees of the Department of Railways and Canals, or of the Intercolonail Railway, for any cause whatever, and relating to any complaints or charges, or to any matter of whatsoever nature, giving in detail the items of all accounts or bills of or payments to the said H. P. Duchemin in connection with same, during the years 1912, 1913, and for the year 1914 to date; together with a statement showing the total amounts paid in each specified investigation and the total paid in each year, for the whole period to the said H. P. Duchemin. Presented March 5, 1914.—*Mr. Emmerson*.....*Not printed.*

93*h*. Supplementary Return to an Order of the House of the 7th May, 1913, for a return showing indetail the names of witnesses summoned by Commissioner H. P. Duchemin in connection with all investigations held by him in the Counties of North Cape Breton and Victoria, South Cape Breton, Inverness and Antigonish, Nova Scotia, and the amounts paid in each such case. Presented March 17, 1914.—*Mr. Carroll*.....*Not printed.*

93*i*. Return to an Order of the House of the 23rd March, 1914, for a return showing in detail the expenses and cost of an inquiry or investigation held by Commissioner Adair, under the authority of the Department of Railways and Canals, into the affairs of the Electrical Branch of the Intercolonial Railway at Moncton, and the conduct of John W. Gaskin and others, in relation to their services in said branch or otherwise, held during the year 1912; together with the names of the commissioner, the agents, attorneys, counsel, constables, police officers, detectives, witnesses or other persons in connection with said inquiry; the number of days consumed and paid for in the conduct thereof, and the services rendered by each person in connection therewith; and a detailed statement of the sum or sums of money paid to each party therefor, at what rate and the amounts paid to each witness sworn and in attendance or otherwise, together with a copy of all bills, claims or accounts rendered in connection with said inquiry, and of all vouchers for moneys paid, by whom paid and to whom; with a copy of all letters or other correspondence relating to the appointment of a commissioner, and of counsel to be engaged or other officers employed, and relating to the compensation to be paid for services, and in connection with any of said bills, accounts, payments and vouchers, with a statement or summary of the total cost of said investigation, showing the number of railway employees called as witnesses, the witness fees allowed and paid them, and the cases in which their time respectively was not allowed them while absent to give such evidence, and the cases to which such time was allowed and no deduction made from their wages or salaries for the period of their absence in attendance at such inquiry as such witnesses respectively. Presented May 13, 1914.—*Mr. Emmerson*....*Not printed.*

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94. Return to an Order of the House of the 9th December, 1912, for a return showing how many citizens of the United States have been employed by the Government since November 1, 1911, in what department employed, their names and occupations and salary paid to each, and also, the number appointed under section 21 of the Civil Service Act. Presented January 24, 1914.—*Mr. Murphy*.....*Not printed.*

95. Return to an Order of the House of the 23rd April, 1913, for a copy of all letters, telegrams, papers and documents in any way relating to the purchase of property at Long Beach St. Mary's, Digby County, N.S., for a lobster pond. Presented January 23, 1914.—*Mr. Law*.....*Not printed.*

96. Return to an Order of the House of the 24th February, 1913, for a copy of all requests, petitions, &c., made to the Government, or any department thereof, by the residents of Mira, County of Cape Breton, for subsidies for boats, wharf accommodations, or increased facilities on the Mira river. Presented January 23, 1914.—*Mr. Carroll.* *Not printed.*

97. Return to an Order of the House of the 7th May, 1913, for a copy of all reports, correspondence, telegrams and other documents in the custody or control of the Militia Department or the Railway Department, concerning matters brought to the attention of the Militia Department by B. A. Ingraham, of Sydney, N.S., with reference to the transportation of the Sydney militia over the Intercolonial Railway in the year 1912. Presented January 23, 1914.—*Mr. Carroll*.....*Not printed.*

98. Medical inspection of immigrants at port of entry in Canada.—(*Senate*.....*Not printed.*

99. Public health service, several branches of R.S. engaged in.—(*Senate*).....*Not printed.*

100. Proposed harbour at Skinner's Pond—Surveys made for, &c.—(*Senate*).....*Not printed.*

101. Investigation held in 1912 *re* dredging operations in British Columbia.—(*Senate*). *Not printed.*

101*a*. Investigation held by Mr. Wilson, B.C., against Captain Murdock Young.—(*Senate*). *Not printed.*

102. Quantities of wheat by grades received at elevators at Fort William.—(*Senate*). *Not printed.*

103. Projected railway or highway bridge over the Restigouche River, N.B. Presented January 26, 1914.—*Mr. Marcil*.....*Not printed.*

104. Relating to the employees of the different departments at Ottawa, the provinces, and territories, &c. Presented January 26, 1914.—*Mr. Wilson (Laval)*.....*Not printed.*

104*a*. Return to an Order of the House of the 11th December, 1912, for a return showing for each department of the Civil Service, the names, ages, offices and salaries of such persons employed either in the inside or outside divisions thereof, and of such persons not in the Civil Service employed by the Government in any department since the 10th October, 1911; and in cases where no commission of investigation was appointed, as have been removed from office by dismissal, superannuation or otherwise, specifying in each case the manner of, and grounds for such removal, and the length of notice given to the person removed, and the amount of superannuation or gratuity granted, if any; also showing the name, age, office and salary or remuneration of any and every person appointed to the Civil Service in the place of, or as a consequence of any such removal. Presented January 26, 1914.—*Mr. Murphy*.....*Not printed.*

104*b*. Partial Return to an Order of the House of the 11th December, 1912, for a return showing for each department of the Civil Service, the names, ages, offices and salaries of such persons employed either in the inside or outside divisions thereof, and of such persons not in the Civil Service employed by the Government in any department since the 10th October, 1911; and in cases where no commission of investigaiton was appointed, as have been removed from office by dismissal, superannuation or otherwise, specifying in each case the manner of, and grounds for such removal, and the length of notice given to the person removed, and the amount of superannuation or gratuity granted, if any; also showing the name, age, office and salary or remuneration of any and every person appointed to the Civil Service in the place of, or as a consequence of any such removal. Presented February 10, 1914.—*Mr. Murphy*.....*Not printed.*

104*c*. Further Supplementary Return to an Order of the House of the 11th December, 1912, for a return showing for each department of the Civil Service, the names, ages, offices and salaries of such persons employed either in the inside or outside divisions thereof, and of such persons not in the Civil Service employed by the Government in any department since the 10th October, 1911; and in cases where no commission of investigation was appointed, as have been removed from office by dismissal, superannuation or otherwise, specifying in each case the manner of, and grounds for such removal, and the length of notice given to the person removed, and the amount of superannuation or gratuity granted, if any; also showing the name, age, office and salary or remuneration of any and every person appointed to the Civil Service in the place of, or as a consequence of any such removal. Presented March 10, 1914.—*Mr. Murphy*.....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

104*d*. Return to an Order of the House of the 23rd February, 1914, for a return showing the total number of officials and employees in the Department of Public Printing and Stationery on February 1, 1914; and the increase in wages granted to the several groups of employees during the year 1913. Presented March 18, 1914.—*Mr. Murphy.* *Not printed.*

104*e*. Return to an Order of the House of the 23rd February, 1914, for a return showing how many persons have been appointed to positions in the inside Civil Service since October 10, 1911, who had not passed the public competitive examination held by the Civil Service Commission in May and November of each year.

2. How many of such persons were appointed in each department. Presented March 23, 1914.—*Mr. Murphy*.....*Not printed.*

104*f*. Return to an order of the House of the 4th March, 1914, for a return showing how many persons have been appointed to the Inside Service of the Post Office Department by the present Government, with the names of the appointees, the grade each of them was appointed to, and the salary in each case; how many of these appointees passed the Civil Service examination, and how many did not do so, with the names in each case. Presented April 1, 1914.—*Mr. Proulx*.....*Not printed.*

104*g*. Further Supplementary Return to an Order of the House of 11th December, 1912, for a return showing for each department of the Civil Service, the names, ages, offices and salaries of such persons employed either in the inside or outside divisions thereof, and of such persons not in the Civil Service employed by the Government in any department since the 10th October, 1911; and in cases where no commission of investigation was appointed, as have been removed from office by dismissal, superannuation or otherwise, specifying in each case the manner of, and grounds for such removal, and the length of notice given to the person removed, and the amount of superannuation or gratuity granted, if any; also showing the name, age, office and salary or remuneration of any and every person appointed to the Civil Service in the place of, or as a consequence of any such removal. Presented April 2, 1914.—*Mr. Murphy*.....*Not printed.*

104*h*. Return to an Order of the House of the 2nd April, 1914, for a return showing how mnay certificates for promotion have been asked from the Civil Service Commissioners since the 31st March, 1913; how many of such certificates have been refused, and to whom, and the reasons given in each case for such refusal. Presented April 16, 1914.—*Mr Carroll* .....*Not printed.*

104*i*. Return to an Order of the House of the 30th March, 1914, for a return showing the salary of each deputy minister; the number of clerks or employees under each of the deputy ministers, or over whose work the deputy is supposed to exercise supervision; the salary of the Customs Commissioner, and length of time employed. Presented April 23, 1914. —*Mr. Chisholm (Inverness)* .....*Not printed.*

105. Return called for by Section 88, of Chapter 62, Revised Statutes of Canada, requiring that the Minister of the Interior shall lay before Parliament, each year, a return of liquor brought from any place out of Canada into the Territories by special permission in writing of the Commissioner of the Northwest Territories. Presented by Hon. Mr. Roche, January 27, 1914 .....*Not printed.*

106. Copy of the Seventh Joint Report of the Commissioners for the Demarcation of the Meridian of the 141st Degree of West Longitude. Presented by Hon. Mr. Roche, January 28, 1913.....*Not printed.*

107. Return showing lands sold by the Canadian Pacific Railway Company during the year which ended on the 1st October, 1913. Presented by Hon. Mr. Roche, January 28, 1914. *Not printed.*

108. Regulations relating to the Parcel Post Service, 1914. Presented by Hon. Mr. Pelletier, January 28, 1914.....*Not printed.*

109. Report of the proceedings of the Commisioners of Internal Economy of the House of Commons for 1912-1913, pursuant to Rule 9. Presented by Mis Honour the Speaker, February 2, 1913 .....*Not printed.*

110. Return of Orders in Council which have been published in the *Canada Gazette* between the 1st October, 1912, and 30th November, 1913, in accordance with the provisions of "The Forest Reserves and Park Act," Section 19, of Chapter 10, 1-2 George V. Presented by Hon. Mr. Roche, February 2, 1914.....*Not printed.*

110*a*. Return of Orders in Council which have been published in the *Canada Gazette*, between the 1st October, 1912, and 30th November, 1913, in accordance with the provisions of Section 5 of "The Dominion Lands Survey Act," Chapter 21, 7-8 Edward VII. *Not printed.*

110*b*. Return of Orders in Council which have been published in the *Canada Gazette*, between 1st October, 1912, and 30th November, 1913, in accordance with the provisions of Section 77 of "The Dominion Lands Act," Chapter 20 of the Statutes of Canada, 1908. *Not printed.*

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110*c*. Return of Orders in Council which have been published in the *Canada Gazette* and in the British Columbia *Gazette*, between 1st October, 1912, and 30th November, 1913, in accordance with provisions of subsection (*d*) of Section 38 of the regulations for the survey, administration, disposal and management of Dominion lands within the 40-mile railway belt in the Province of British Columbia. Presented by Hon. Mr. Roche, February 2, 1914.....*Not printed.*

110*d*. Return of copies of all Orders in Council, plans, papers and correspondence which are required to be presented to the House of Commons, under a resolution passed on the 20th February, 1882, since the date of the last return, under such resolution. Presented by Hon. Mr. Roche, January 28, 1914.....*Not printed.*

110*e*. Return to an Order of the House of the 9th February, 1914, for a copy of all letters, papers, homestead inspector's reports, declarations and of all other documents connected in any way with the entry and cancellation proceedings against the homestead entry of James Bruce for the southeast quarter section 36, in townshpi 49, range 27, West second meridian. Presented March 6, 1914.—*Mr. Neely*.....*Not printed.*

110*f*. Return to an Order of the House of the 9th February, 1914, for a copy of all papers in connection with the disposition of the S.E. ¼, section 16, township 25, range 5, West fifth meridian. Presented March 10, 1914.—*Mr. Oliver*.....*Not printed.*

110*g*. Return to an Order of the House of the 16th February, 1914, for a copy of all papers in connection with the S.W. ¼, 23-16-12 W, 3 M. Presented March 10, 1914.—*Mr. Knowles* .....*Not printed.*

110*h*. Return to an Order of the House of the 16th February, 1914, for a copy of all papers in connection with the N.E. ¼-22-11-5-W. 3 M. Presented March 23, 1914.—*Mr. Knowles. Not printed.*

110*i*. Return to an Order of the House of the 2nd February, 1914, for a copy of all letters, telegrams and papers concerning coal lands situate in 28-19, 27-18, 27-17 and 28-18 West of the fourth meridian. Presented April 21, 1914.—*Mr. Buchanan*.....*Not printed.*

110*j*. Supplementary Return to an Order of the House of the 16th February, 1914, for a copy of all papers in connection with the N.E. ¼-22-11-5 W. 3 M. Presented May 5, 1914.—*Mr. Knowles* .....*Not printed.*

110*k*. Return to an Address to His Royal Highness the Governor General of the 20th April, 1914, for a copy of all documents, letters, telegrams, papers, Orders in Council and agreements of sale, in connection with the sale by the Government of Canada of the following lands in the railway belt in British Columbia, viz.: Townships 23 and 24, range 18; townships 23 and 24, range 19; townships 24 and 25, range 20; townships 25, 26 and 27, range 21; townships 26 and 27, range 22, all West of the fifth meridian. Presented May 18, 1914.—*Mr. Buchanan*.....*Not printed.*

110*l*. Return to an Order of the House of the 27th April, 1914, for a copy of all letters, telegrams, &c., in the Department of the Interior in connection with the N.W. ¼ section 20-4, range 16 west of the second meridian. Presented May 18, 1914.—*Mr. Turriff. Not printed.*

110*m*. Return to an Order of the House of the 27th April, 1914, for a copy of all papers, letters, telegrams, &c., in possession of the Department of the Interior in connection with the N-½-1-3-16-W. 2-M. Presented May 18, 1914.—*Mr. Turriff*.....*Not printed.*

111. Correspondence between the Imperial Government and the Government of Canada, and other documents, relating to Imperial Naturalization. Presented by Hon. Mr. Doherty, February 4, 1914 .....*Not printed.*

111*a*. Return to an Oder of the House of the 2nd February, 1914, for a copy of all correspondence and documents, or other information, as to the passage of an Act in Great Britain and the different Dominions, providing for uniformity of the Naturalization Law. Presented February 18, 1914.—*Mr. Macdonald* .....*Not printed.*

112. Account of the average number of men employed on the Dominion Police Force during each month of the year 1913, and of their pay and travelling expenses, pursuant to Chapter 92, section 6, subsection 2, of the Revised Statutes of Canada. Presented by Hon. Mr. Doherty, February 5, 1914.....*Not printed.*

113. Copy of Agreement between the Government of Canada and the Royal Mail Steam Packet Company, for a steamship service between Canada and the British West Indies. Presented by Hon. Mr. Foster, February 9, 1914.....*Not printed.*

114. Return to an Order of the House of the 2nd February, 1914, for a return showing what changes have been made in the original scheme for terminals of the Transcontinental Railway at the city of Quebec; the estimated cost of the former; the estimated cost of the said terminals under the present scheme. Presented February 10, 1914.—*Mr. Graham* .....*Not printed.*

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114*a*. Return to an Address to His Royal Highness the Governor General of the 23rd February, 1914, for a copy of all correspondence between the National Transcontinental Railway Commissioner and the Minister of Railways, and between the National Transcontinental Railway Commissioner and the Canadian Pacific Railway regarding the Joint Terminals at Quebec; also a copy of the Order in Council regarding joint terminals at Quebec, and of the final agreement regarding same. Presented March 16, 1914.—*Mr. Graham.* *Not printed.*

114*b*. Return to an Order of the House of the 16th March, 1914, for a copy of all contracts by the Department of Railways or the Transcontinental Railway Commission with the Canadian Pacific Railway Company with regard to the establishment of a joint station at the Palais, city of Quebec, and of all correspondence with regard to the same. Presented March 20, 1914.—*Sir Wilfrid Laurier*.....*Not printed.*

115. Return to an Order of the House of the 9th December, 1912, for a return showing the number of commissioners appointed by the Government since October 10, 1911, to hold investigations, giving their names, the amount paid to each commissioner up to November 21, 1912, the number of the said commissioners still under pay, with their names. Presented February 10, 1914.—*Mr. Murphy*.....*Not printed.*

116. Return to an Order of the House of the 31st March, 1913, for a copy of all papers, documents, correspondence, &c., relating to requests for the temporary suspension of the application of the dumping clause of the Customs Tariff Act in reference to wire rods or any other products or articles, made to Department of Customs, or the Department of Finance, since November 1, 1911. Presented February 10, 1914.—*Mr. Maclean* (*Halifax*) .....*Not printed.*

117. Return to an Order of the House of the 20th January, 1913, for a copy of all proposals, offers, agreements, reports, estimates, letters, telegrams and of all other communications or documents in the possession of the Department of Railways and Canals, or of the Prime Minister of Canada, or of any other department of the Government, filed with said department or any of them, since the first day of January, 1910, relating to or in any way appertaining to the question or proposal of acquiring any or all, or any one of the lines of railways connecting with the Intercolonial Railway along its line, and serving as a feeder or feeders of said railway, either by lease, purchase or otherwise, also of all proposals, offers, requests, applications, petitions, memorials, or other documents, and of all letters, telegrams and other communications and correspondence, relating to or in any manner appertaining to the acquisition by any Railway company of running rights, so called, or the securing of a leasehold or other interest involving the rights by any Railway company to operate its trains over the rails of the Intercolonial Railway, together with a copy of all answers, letters, telegrams, correspondence and reports relating thereto, on the files of the Department of Railways and Canals, or of the Prime Minister, or of any Department of the Government. Presented February 10 1914.—*Mr. Emmerson* .....*Not printed.*

117*a*. Return to an Order of the House of the 2nd February, 1914, for a copy of all correspondence, memorials, petitions, engineers' reports and other documents exchanged by or on behalf of the proprietors of the Quebec Oriental Railway and the Atlantic, Quebec and Western Railway, and the Department of Railways and Canals, since last session, with the view of the acquisition by the Government of these roads as branch lines or feeders of the Intercolonial Railway. Presented March 6, 1914.—*Mr. Marcil* (*Bonaventure*). *Not printed.*

117*b*. Return to an Order of the House of the 9th February, 1914, for a copy of all letters, telegrams, petitions, reports, cvorrespondence and other documents on file in any Department of the Government, or in the possession of any member of the Government, relating to, or in any manner connected with, the proposal to have a spur line or siding to connect the new public wharf at Sackville, N.B., with the Intercolonial Railway at that place, and of all letters, telegrams and other correspondence passed between any person or persons and any member of the Government. Presented March 11, 1914.—*Mr. Emmerson* .....*Not printed.*

117*c*. Return to an Order of the House of December 9, 1912, for a copy of the report made by Mr. Tessier to the Department of Railways and Canals on a proposed line of railway from Orangedale to Cheticamp in the County of Inverness, N.S.; and also all petitions, memorials and correspondence referring to the proposed line of railway. Presented March 17, 1914.—*Mr. Chisholm* (*Antigonish*).....*Not printed.*

117*d*. Return to an Order of the House of the 23rd March, 1914, for a copy of all petitions, correspondence, engineers' reports of surveys and of all other reports on file, referring to a proposed diversion of the Intercolonial Railway from, at or near Linwood Station, through the districts of Linwood, Cape Jack and to village of Harbour au Bouché; and more particularly of the petitions and reports relating to such diversion filed in or about the years 1887 and 1891. Presented April 7, 1914.—*Mr. Chisholm* (*Antigonish*). *Not printed.*

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117e. Return to an Order of the House of the 23rd March, 1914, for a return showing the names of the successful contractors, with the particulars of their schedule prices respectively, on the contracts awarded by the Intercolonial Railway for the work of double tracking from Chaudiere Curve to St. Romuald, Quebec, and the division line from Nelson to Derby Junction, New Brunswick, and the division or spur line from North Sidney to Leitche's Creek, Nova Scotia, with a copy of the reports, correspondence and recommendations relating to the awarding of said tenders or contracts respectively, and also showing the estimate of cost of said works respectively. Presented April 15, 1914.—*Mr. Emmerson* ..... *Not printed.*

117f. Return to an Order of the House of the 16th March, 1914, for a copy of all memoranda, instructions and authorizations issued by the Minister of Railways and Canals since October 11, 1911, relating to the eliminating of the present grades and replacing the light bridges with heavier steel structure on the Intercolonial Railway; and of all memoranda, recommendations and reports made by Mr. F. P. Gutelius or the Board of Management of the Intercolonial Railway thereon. Presented May 6, 1914.—*Mr. Kyte.*
Not printed.

118. Memorandum of special claim on behalf of Prince Edward Island in respect to representation in the House of Commons. Presented by Hon. Mr. Foster, February 10, 1914.
Printed for distribution and sessional papers.

118a. Memorandum on behalf of Nova Scotia, New Brunswick and Prince Edward Island, claiming the right to have their original representation in the House of Commons restored. Presented by Hon. Mr. Foster, February 10, 1914.
Printed for distribution and sessional papers.

119. Copy of the proceedings and resolutions adopted at the last Interprovincial Conference. Presented by Hon. Mr. Foster, February 10, 1914.
Printed for distribution and sessional papers.

119a. Minutes of the Proceedings in Conference of the representatives of the Provinces, October, 1913. Presented by Hon. Mr. Borden, March 11, 1914..... *Not printed.*

120. Return to an Order of the House of the 2nd June, 1913, for a copy of the application of Pacifique Leroux for damages sustained by removal of a bridge on the Soulanges Canal, and of all reports and correspondence on the same. Presented February 12, 1914.—*Sir Wilfrid Laurier* ..... *Not printed.*

121. Return to an Order of the House of the 20th January, 1913, for a copy of all plans, proposals, diagrams, specifications, reports, surveys, requests, correspondence, letters, telegrams and of all other communications and documents in possession of the Department of Railways and Canals, relating or in any wise appertaining to the proposed steam ferry service for all seasons of the year between the mainland of New Brunswick, or of Nova Scotia, and Prince Edward Island, whereby a connection could be made between the Intercolonial Railway and the Prince Edward Island Railway, by the transfer of railway cars over and across the waters of the Straits of Northumberland by means of said proposed ferry, together with a statement of all estimates and figures as to the total cost of the installation of such ferry, and the items of said estimate or estimates in detail. Presented February 12, 1914.—*Mr. Emmerson*..... *Not printed.*

121a. Return to an Order of the House of the 11th December, 1912, for a copy of all letters, telegrams and other documents relative to the establishment of a car ferry between Prince Edward Island and the mainland, of the report or reports of any engineers or experts in regard to the said proposal, and of their estimates of the cost thereof, the advertisement calling for tenders therefor, and a copy of any plans, conditions or proposed specifications therefor, or in regard thereto, and of any tenders received in response to said advertisement, of the reports, if any, of any officials in regard thereto, and of all data in possession of the Department in respect of said project. Presented February 12, 1914.—*Mr. Macdonald*..... *Not printed.*

122. Return to an Order of the House of the 2nd February, 1914, for a return showing the total amount of liability in the form of temporary loans on the last day of each month during the period between the 1st day of May, 1913, and December 31, 1913, together with, in each case, the rate of interest paid upon said amounts during the same periods. Presented February 12, 1914.—*Mr. Maclean (Halifax)*..... *Not printed.*

123. Report of the Royal Commission appointed to investigate the construction of the National Transcontinental Railway, together with the evidence taken and exhibits filed before the said commission. Presented by Hon. Mr. Cochrane, February 12, 1914.
Printed for distribution and sessional papers.

123a. Return to an Order of the House of the 23rd February, 1914, for a copy of the assignment by M. P. and J. T. Davis in September, 1909, of contracts numbers 16 and 17 on the National Transcontinental Railway to O'Brien, Fowler and McDougall, and of the Transcontinental Commissioner's approval thereof, in the said month of September, 1909. Presented March 4, 1914.—*Mr. Graham*..... *Not printed.*

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123*b*. Return to an Order of the House of the 18th February, 1914, for a copy of the contract with Mr. Joseph Gosselin for the locomotive and car shops at St. Malo, and of all telegrams, letters and correspondence between the Department and Mr. W. J. Press, mechanical engineer, or the chief engineer, with regard to change of the price of 85 cents per cubic yard for common excavation to the price of $2.30 per cubic yard for frozen earth. Presented March 11, 1914.—*Mr. Graham*.....*Not printed.*

123*c*. Return to an Address to His Royal Highness the Governor General of the 16th February, 1914, for a copy of all papers in any way relating to the tender, original contract, and amended contract of Mr. Joseph Gosselin for the locomotive and car shops at St. Malo, Quebec, together with a copy of the advertisements for tenders, the specifications, the contract, the amended contract, reports of engineers, recommendations to Council, Orders in Council, letters, telegrams, minutes or reports of interviews, and of all other documents referring in any way to the said contract or the amendment thereof. Presented March 11, 1914.—*Mr. Graham*.....*Not printed.*

123*d*. Return to an Address to His Royal Highness the Governor General of the 23rd February, 1914, for a copy of all correspondence in connection with the appointment of Messrs. Lynch-Staunton and Gutelius as commissioners to investigate the cost of construction of the Eastern division of the National Transcontinental Railway, and also of the Order in Council appointing them. Presented March 12, 1914.—*Mr. Graham.* *Not printed.*

123*e*. Return to an Order of the House of the 23rd February, 1914, for a copy of the report of Geo. S. Hodgins, of New York, regarding the Transcona shops of the Transcontinental Railway, dated June 10, 1912. Presented March 19, 1914.—*Mr. Graham*..*Not printed.*

123*f*. Return to an Order of the House of the 23rd March, 1914, for a copy of all plans and profiles designed by the engineers, in connection with the intended construction of the Transcontinental Railway from a point called Ste. Claire, County of Dorchester, between the twentieth and thirtieth miles, east of the Quebec Bridge, going through the parishes of St. Malachie, Standon, Cranbourne , Ste. Germaine and Ste. Justine, passing through the townships of Panet, Rolette and Valois, towards Ste. Perpetue, on the 105th mile east of the Quebec bridge, and of all the information and reports on the nature of land, timber and minerals of the places through which the engineers have been, showing also how much the railway would have cost per mile had it been built in that part of the country. Presented April 7, 1914.—*Mr. Sevigny*.....*Not printed.*

123*g*. Return to an Order of the House of the 23rd March, 1914, for a copy of all correspondence, messages, petitions, and other documents in connection with the choice of a site intended for the construction of a station at the village of St. Eleuthere, on the National Transcontinental Railway. Presented April 15, 1914.—*Mr. Lapointe* (*Kamouraska*) .....*Not printed.*

123*h*. Return to an Order of the House for a return showing.—

1. What kind of coaling plants have been provided on the National Transcontinental Railway?
2. How many have been provided?
3. Where they have been constructed?
4. If any tenders were called for them?
5. The name and address of the lowest tenderer.
6. From whom they were obtained and at what price? Presented April 15, 1914. —*Mr. Macdonald* .....*Not printed.*

124. Return to an Address to His Royal Highness the Governor General, of the 2nd February, 1914, for a copy of all decisions of the Board of Railway Commisioners made on or after the 10th of October, 1911, on which appeals have been taken to the Governor in Council, and of all decisions given by the Governor in Council on such appeals. Presented February 13, 1914.—*Mr. Sinclair*.....*Not printed.*

125. Return to an Order of the House of the 2nd February, 1914, for a copy of all rules and regulations made and passed by the Board, with the approval of the Minister, under the provisions of the Intercolonial and Prince Edward Island Railways Employees' Provident Fund Act, pursuant to section eight of said Act. Presented February 13, 1914.—*Mr. Emmerson* .....*Not printed.*

125*a*. Return to an Order of the House of the 2nd February, 1914, for a return showing in detail the transactions and proceedings of the so-called Provident Fund Board from the 1st day of January, A.D., 1912, to date, with the names of applicants and their addresses and the nature of their employment, for retirement under the provisions of The Intercolonial and Prince Edward Island Railways Employees' Provident Fund Act, and a statement of the names so retired during that period, showing the amount of their respective retiring allowances, their respective terms of service, their respective ages, and the total of the fixed yearly charges upon the said fund made thereby; together

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with a copy of all correspondence, letters, documents and other communications relating to such applications and retirements on file in the Railway Department either at Moncton or at Ottawa, and of all correspondence, letters, petitions or other communications addressed to and received by the Minister of Railways and Canals, the Department, or any official thereof, or any member of the Government from any member of Parliament, or other person charged with the responsibility of directing Government or railway patronage, or from any person or persons, club or association assuming to advise or direct with respect to any such patronage, and of all replies made to any such letters, petitions or other communications. Presented March 3, 1914.—*Mr. Emmerson* ..... *Not printed.*

126. Return to an Order of the House of the 2nd February, 1914, for a return showing the amounts of receipts and expenditures on the Intercolonial Railway during the months of April, May and June, of 1913, respectively, giving separately the revenue from passenger trains, freight traffic, mails and express and miscellaneous revenue, respectively, with the total thereof during that period; also the same information respecting the corresponding months of 1912, with the total thereof for that period. Also a statement showing the working expenses or expenditure during months of April, May and June of 1913, respectively, giving separately the working expenses or expenditure on maintenance of way and structures, maintenance of equipment, traffic expenses, transportation expenses and general expenses; with the total thereof during that period; and also the same information respecting the corresponding months of 1912, with the total thereof for the same period; also a statement showing the cost of transporting freight per ton mile during the period named in the years 1912 and 1913. Presented February 13, 1914.—*Mr. Emmerson*.....*Not printed.*

126*a*. Return to an Order of the House of the 4th March, 1914, for a return showing the total revenue of the Intercolonial Railway during the fiscal year 1912-1913, and the revenue from Campbellton and all stations east of Campbellton, and from those west thereof as far as Halifax, on the main line, including the branches east of Campbellton, Prince Edward Island Railway excluded. Presented March 17, 1914.—*Mr. Boulay.*
Not printed.

126*b*. Return to an Order of the House of the 2nd February, 1914, for a return showing the total earnings of the Intercolonial Railway on Division 3 in connection with passenger traffic for the calendar years 1910, 1911, 1912 and 1913 respectively, and the monthly passenger traffic earnings for each of the said years; the total expenses or expenditures connected with the said passenger traffic on said division during the said years respectively; together with a statement showing the monthly passenger traffic expenses or expenditures connected with said passenger traffic for each of the months during the said years; and showing, in addition, the loss and surplus for each of said years and the months thereof respectively, in connection with the passenger traffic on said division 3 between St. John and Halifax; also a statement of the revenue and expenditures on the transactions connected with said passenger traffic over said division during the months of December, 1913, and January, 1914, separately; and also a statement showing the gross passenger earnings for December, 1912, and January, 1914, respectively, and the gross expenditures with the passenger traffic for the said months respectively; together with a copy of all reports, returns, letters and correspondence relating to the earnings, expenditures or losses or surpluses on said division either in connection with freight or passenger traffic. Presented April 7, 1914.—*Mr. Emmerson*....*Not printed.*

127. Return to an Order of the House of the 2nd February, 1914, for a return showing the names of the employees of all kinds on the Soulanges Canal in the section extending from the foot of the canal to the first bridge; with the functions of each of them, the salary thereto attached and the date of their hiring during the season of navigation. Presented February 13, 1914.—*Mr. Boyer*.....*Not printed.*

128. Return to an Order of the House of the 3rd February, 1914, for a return showing:—

1. The names of all persons from whom land or property has been expropriated for right of way and station purposes in connection with the Dartmouth to Dean Settlement Branch of the Intercolonial Railway of Canada.
2. The quantity of land or property so expropriated.
3. The amount paid or offered to such person or persons for such land or property, in cases where payment or an offer has been made. Presented February 13, 1914.—*Mr. Maclean (Halifax)* .....*Not printed.*

129. Copy of the International Convention for the safety of human life at sea. Presented by Hon. Mr. Hazen, February 16, 1914.....*Printed for distribution and sessional papers.*

129*a*. Return to an Address to His Royal Highness the Governor General of the 2nd February, 1914, for a copy of all correspondence with the Imperial authorities, or any commercial bodies, on the subject of Safety of Life at Sea; and of the Order in Council appointing representatives of Canada on the International Conference on Safety of Life at Sea. Presented February 20, 1914.—*Sir Wilfrid Laurier*.....*Not printed.*

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130. Return to an Order of the House of the 9th February, 1914, for a copy of all accounts, bills, receipts and vouchers in connection with the services of N. W. White, during 1912 and 1913, as commissioner to inquire into Indian lands in the Province of British Columbia. Presented February 17, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

131. Return to an Order of the House of the 2nd February, 1914, for a copy of all documents whatsoever relating to the investigation of a claim of Jean Ross or Joseph Ross, of Anqui, County of Rimouski, Province of Quebec, against the Intercolonial Railway, following an accident to a horse, which occurred on the 10th of December, 1906. Presented February 17, 1914.—*Mr. Boulay*.....*Not printed.*

132. Copy of the Order in Council appointing a commission to investigate the cost of living. Presented February 17, 1914.—*Sir Wilfrid Laurier*.....*Not printed.*

133. Statement of the population of Canada and its Provinces and Territories in the years 1871, 1881, 1891, 1901 and 1911, according to the census returns. Presented by Hon. Mr. Borden, February 17, 1914.....*Not printed.*

134. Return to an Order of the House of the 9th February, 1914, for a copy of all protests, if any, by the Grand Trunk Pacific Railway Company, against changes in grades of the National Transcontinental Railway from Winnipeg eastward, and terminal facilities at Quebec; of all subsequent approvals of such changes, if any, by the Grand Trunk Pacific Railway Company, and of all correspondence on the above subject. Presented February 18, 1914.—*Sir W. Laurier*.....*Not printed.*

135. Copy of Second Interim Report of the Royal Commission on the natural resources, trade and legislation of certain portions of His Majesty's Dominions, together with the Minutes of Evidence taken in Australia and New Zealand in 1913, in connection therewith. Presented by Hon. Mr. Foster, February 18, 1914.....*Not printed.*

136. Return to an Order of the Senate dated 27th January, 1914, for a copy of the Annual Report made in January, 1913, by the Central Railway Company to the Railway Department.—(*Senate*) .....*Not printed.*

137. Return to an Order of the Senate dated 27th January, 1914, for a copy of the Annual Report made by the Salisbury and Albert Railway Company to the Railway Department.—(*Senate*) .....*Not printed.*

138. Return to an Order of the House of the 9th February, 1914, for a copy of all correspondence and documents in reference to the matter submitted to Sir William Whyte by the Government, the Transcontinental Commission or the commission appointed to investigate the construction of the National Transcontinental Railway, between the Government or any member or official thereof, and any official of the Grand Trunk Pacific Railway Company; and also of all correspondence between any member or official of either the above named commissions and the Justice Department, concerning the said matter. Presented February 19, 1914.—*Mr. Graham*.....*Not printed.*

139. Return to an Order of the House of the 16th February, 1914, for a return showing the names, salaries and grades of the private secretaries of the members of the Liberal Government on October, 1911; the names of the private secretaries employed from time to time by the members of the present Government, and the salary and grade of each. Presented February 19, 1914.—*Mr. Murphy*.....*Not printed.*

140. Return to an Order of the House of the 9th February, 1914, for a return showing how many woollen industries are operated in the country; where situated, in which province, and in what city, town or village; the number of hands employed in each, and the output for each during 1913. Presented February 19, 1914.—*Mr. Verville.*
Not printed.

141. Return to an Order of the House of the 2nd February, 1914, for a return showing the number, location, and mileage of rural mail routes established in Bonaventure County from October, 1911, to date, if any; together with a copy of all applications, memorials, reports and correspondence generally on this matter. Presented February 23, 1914.—*Mr. Marcil (Bonaventure)* .....*Not printed.*

141*a*. Return to an Order of the House of the 2nd February, 1914, for a return showing a tabulated statement of the number of rural mail delivery routes opened since 1911, including the number of boxes used; also the new mail delivery contracts necessitated by the establishment of said routes in each county, not already moved for. Presented February 23, 1914.—*Mr. Lemieux*.....*Not printed.*

141*b*. Return to an Order of the House of the 19th February, 1914, for a return showing the number of rural mail delivery routes which have been established in Nova Scotia, and their names; and if any of the routes are provided with a daily service. Presented March 2, 1914.—*Mr. Sinclair*.....*Not printed.*

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141*c*. Return to an Order of the House of the 18th February, 1914, for a copy of all documents, petitions, letters, telegrams, &c., exchanged between any one and the Post Office Department, in connection with the establishing of a rural mail service in the Parish of Ste. Marguerite de Blairfindie, County of St. Johns and Iberville, and of all documents, letters and telegrams, &c., relating to the contracts for the conveyance of rural mail in said parish. Presented April 29, 1914.—*Mr. Demers*.....*Not printed.*

141*d*. Return to an Order of the House of the 20th April, 1914, for a return showing:—

1. Whether the rural postal delivery service has been started in the County of Quebec? If so, when and in what parishes of said county?

2. Whether public tenders have been advertised for such service? If so, when, how many were received and from whom, the amount of each tender, and what tender was accepted?

3. The price of the accepted tender, the name of the tenderer, the condition or conditions of payment, and the length of the contract. Presented April 30, 1914.—*Mr. Lachance*.....*Not printed.*

141*e*. Return to an Order of the House of the 6th April, 1914, for a copy of all letters, petitions and documents relative to the establishment of a rural mail delivery route from New Glasgow through Mount William, Granton and Abercrombie, County of Pictou. Presented May 8, 1914.—*Mr. Macdonald*.....*Not printed.*

141*f*. Return to an Order of the House of the 4th March, 1914, for a copy of all correspondence, telegrams, petition, recommendation and other documents relating to the establistment of the rural mail service in the parish of St. Theodore d'Acton. Presented May 16, 1914.—*Mr. Marcil (Bonaventure)*.....*Not printed.*

141 (*g*). Return to an Order of the House of the 11th February, 1914, for a copy of all petitions, letters, telegrams and other papers relative to the establishment of rural mail delivery routes in the County of Pictou since January 1, 1912, together with the number of said routes, the carriers on each route, the tenders received in each case for the service, a copy of the correspondence in relation to said tenders and their acceptance, and the post offices closed or to be closed as the result of the establishment of said routes. Presented June 12, 1914.—*Mr. Macdonald*.....*Not printed.*

142. Return to an Order of the House of the 2nd February, 1914, for a return showing what new post offices have been established in the County of L'Islet since 1911; the names of the officer in charge of each of them; the revenue brought; the expenses incurred by these offices, including the salary and fees of the postmaster and charges for the conveyance of the mails; if these officers have been asked for by opetitions of the interested ratepayers, and if so, by whom; the quantity of letters and other postal matters that have passed through each of these offices since they have been established. Presented February 23, 1914.—*Mr. Lapointe (Kamouraska)*.....*Not printed.*

142*a*. Return to an Order of the House of the 30th March, 1914, for a copy of all documents, papers, petitions, correspondence, reports, &c., in connection with the opening of a post office under the name of Glasson in the parish of St. Aubert, County of L'Islet. Presented April 22, 1914.—*Mr. Lapointe (Kamouraska)*.....*Not printed.*

143. Return to an Order of the House of the 2nd February, 1914, for a return showing the names and addresses, with rank or occupation, of all persons who accompanied the Minister of Militia and Defence to the Old country and Europe during the summer of 1913, and whose expenses were paid wholly or in part by the Dominion Government, or who were paid salary or allowance during such time, with the amount paid to each person. Presented February 23, 1914.—*Mr. Carvell*.....*Not printed.*

144. Return to an Order of the House of the 11th February, 1914, for a copy of all correspondence, telegrams and other papers to be found in the Department of the Naval Service in connection with the death and burial, at Montreal, of Joseph LeBlanc, a sailor on D.G.S. *Canada*. Presented February 23, 1914.—*Mr. Sinclair*..*Not printed.*

145. Return to an Order of the House of the 2nd February, 1914, for a copy of all tenders received for the construction of a salmon hatchery on Nipissiguit river, Gloucester County, N.B., and of the contract awarded. Presented February 23, 1914.—*Mr. Turgeon*.....*Not printed.*

146. Return to an Order of the House of the 9th April, 1913, for a copy of all correspondence, telegrams, petitions, affidavits, certificates, reports, complaints and other documents, relating to the resignation of Mr. M. C. Blais, recruiting officer of the Department of Marine and Fisheries from the Government shipyards at St. Joseph de Sorel, and to the appointment of Mr. F. P. Vanasse to this office. Presented February 23, 1914.—*Mr. Cardin*.....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

147. Return to an Order of the House of the 9th February, 1914, for a copy of all correspondence, letters, telegrams, and other documents relating to industrial disputes during the year 1913, between the operators and employees of any of the companies operating coal mines on Vancouver Island, and disturbances arising out of the same; and of any correspondence, either before or since the year 1913, with respect to any of the said disputes. And in particular of all correspondence, letters, telegrams, and other documents to or from the Prime Minister, the Honourable the Minister of Labour or any of the officers of the Department of Labour, respecting attempts at conciliation in connection with these disputes, and to or from the Honourable the Minister of Militia, or any officers of the Department of Militia and the Honourable the Minister of Justice, or any officers of the Department of Justice, respecting the calling out and services of the militia in connection with said disputes; and a statement of the arrests made and of convictions, if any, for infringement of the laws. Also a copy of the evidence taken and reports of investigations made by the Honourable the Minister of Labour, Mr. Samuel Price, Commissioner appointed by the Department of Labour, and of the Deputy Minister of Labour; together with a detailed statement of the expenses of all such investigations and expenses otherwise incurred by any of the Departments of the Government in consequence of said disputes or difficulties arising out of same. Presented February 23, 1914.—*Sir W. Laurier*.....*Not printed.*

147*a*. Return to an Address to His Royal Highness the Governor General of the 2nd February, 1914, for a copy of all correspondence, letters, telegrams and reports that have been exchanged between the Government and the strikers and operators of coal mines in British Columbia since the beginning of the strike until the present; also a copy of all Orders in Council in connection with said strike. Presented February 23, 1914.—*Mr. Verville* .....*Not printed.*

147*b*. Supplementary Return to an Order of the House of the 9th February, 1914, for a copy of all correspondence, letters, telegrams, and other documents relating to industrial disputes during the year 1913, between the operators and employees of any of the companies operating coal mines on Vancouver Island, and disturbances arising out of the same; and of any correspondence, either before or since the year 1913 with respect to any of the said disputes. And in particular of all correspondence, letters, telegrams, and other documents to or from the Prime Minister, the Honourable the Minister of Labour or any of the officers of the Department of Labour, respecting attempts at conciliation in connection with these disputes, and to or from the Honourable the Minister of Militia, or any officers of the Department of Militia and the Honourable the Minister of Justice, or any officers of the Department of Justice, respecting the calling out and services of the militia in connection with said disputes; and a statement of the arrests made and of convictions if any, for infringement of the laws. Also a copy of the evidence taken and reports of investigations made by the Honourable the Minister of Labour, Mr. Samuel Price, Commissioner appointed by the Department of Labour, and of the Deputy Minister of Labour; together with a detailed statement of the expenses of all such investigations and expenses otherwise incurred by any of the Departments of the Government in consequence of said disputes or difficulties arising out of same. Presented February 24, 1914.—*Sir Wilfrid Laurier*.....*Not printed.*

148. Regulations, approved by Order in Council ,dated the 19th day of January, 1914, for the disposal of petroleum and natural gas rights, the property of the Crown in Manitoba, Saskatchewan, Alberta, the Northwest Territories, the Yukon Territory, the Railway Belt in the Province of British Columbia, and within the tract containing three and one-half (3½) million acres of land acquired by the Dominion Government from the Province of British Columbia, and referred to in subsection (*b*) of section 3 of the Dominion Lands Act. Presented by Hon. Mr. Roche, February 23, 1914.
Not printed.

149. Regulations in regard to grazing leases of vacant Dominion lands, &c. Presented by Hon. Mr. Roche, February 23, 1914.....*Not printed.*

150. Return to an Order of the House of the 9th February, 1914, for a return showing the amounts in detail paid to Ward Fisher, of Shelburne, N.S., fishery inspector, for the years 1912 and 1913 for salary, office expenses, travelling expenses, and all other expenses. Presented February 24, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

151. Return to an Order of the House of the 2nd February, 1914, for a copy of the report of operations at the fishery hatchery at Port Daniel West, for the year 1913. Presented February 24, 1914.—*Mr. Marcil (Bonaventure)* .....*Not printed.*

152. Return to an Order of the House of the 18th February, 1914, for a copy of all correspondence, investigations or other documents respecting the loss of a horse killed on the Intercolonial, on the 10th of September last, the property of Johnny Roy, of Amqui. Presented February 24, 1914.—*Mr. Boulay*.....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

153. Return to an Order of the House of the 16th February, 1914, for a return showing the increase in freight rates on live-stock, including horses, carried over the Intercolonial Railway, by the tariff effective May 1, 1913, as compared with the tariff effective April 15, 1909, for the following distances, respectively:—

Over	5	and not over		10	miles.
"	10	"	"	15	"
"	15	"	"	20	"
"	20	"	"	25	"
"	25	"	"	30	"
"	30	"	"	40	"
"	40	"	"	50	"
"	50	"	"	60	"
"	60	"	"	70	"
"	70	"	"	80	"
"	80	"	"	90	"
"	90	"	"	100	"
"	100	"	"	110	"
"	110	"	"	120	"
"	120	"	"	130	"
"	130	"	"	140	"
"	140	"	"	150	"
"	150	"	"	160	"

Presented February 24, 1914.—*Mr. Kyte*.....*Not printed.*

154. Return to an Order of the House of the 9th February, 1914, for a copy of all correspondence, letters, telegrams, and other documents relative to the report and recommendations of the Board appointed under the Combines Investigation Act to investigate the methods adopted by the United Shoe Machinery Company. Presented February 24, 1914.—*Sir Wilfrid Laurier*.....*Not printed.*

155. Return to an Address to His Royal Highness the Governor General of the 2nd February, 1914, for a copy of memorandum of agreement between the Canadian Government railways and the Canadian Pacific Railway Company, covering the transportation of freight and passengers between Halifax and St. John over the Intercolonial Railway, in connection with the Canadian Pacific and Allan Line Steamships, carrying British mails, making Halifax the terminal port; also of all agreements, Orders in Council, petitions, memorials, regulations or orders of the Department of Railways and Canals, or of any officer or officers of the Intercolonial Railway; of letters or other correspondence, interviews with the Prime Minister and other member or members of the Government, and representations to the Prime Minister, or other member or members of the Government, in any manner relating to the said memorandum of agreement; and of all telegrams and letters received by the Government, or any member thereof, or sent by them, either in reply or otherwise; also of all letters, telegrams, representations or other documents relating to the said agreement or in any way connected therewith, received by F. P. Gutelius, the General Manager of the Intercolonial Railway, from the Canadian Pacific Railway, or from any corporation, persons or body, or sent by him, in reply thereto or otherwise, to the said Canadian Pacific Railway or to any other corporation, body or person. Presented February 24, 1914.—*Mr. Emmerson*..*Not printed.*

156. Return to an Address to His Royal Highness the Governor General of the 9th February, 1914, for a copy of all Orders in Council since the 1st of June last in any way altering the rates of duties existing under the Customs Act. Presented February 24, 1914.—*Sir Wilfrid Laurier*.....*Not printed.*

157. Correspondence, statements, &c., in respect to certain proposed advances to the Harbour Commissioners of Montreal, for expenditure during the years 1914, 1915, 1916 and 1917. Presented by Hon. Mr. Hazen, February 27, 1914.....*Not printed.*

158. Memorandum of proposed harbour improvements to be made by the Harbour Commissioners of Quebec during 1914, out of certain proposed advances to be made to the said commission. Presented by Hon. Mr. Hazen, February 27, 1914.....*Not printed.*

159. Return to an Order of the House of the 2nd February, 1914, for a copy of all papers, correspondence, telegrams, &c., between the Department of Trade and Commerce and any person or persons, companies or corporations, in the years 1912 and 1913, respecting a steamship service between St. John, N.B., and Bear River, N.S., and intermediate points, and the matter of the payment of a subsidy therefor. Presented March 2, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

160. Return to an Order of the House of the 2nd February, 1914, for a copy of the reports made by the proprietors of the steamer *Canada*, on which the subsidy was paid to them for the season of 1913, for the service between Campbellton, N.B., and Gaspé, Que.; together with a copy of all complaints regarding the said service and of the correspondence, reports and documents in the possession of the Department of Trade and Commerce in that connection in the said year. Presented March 2, 1914.—*Mr. Marcil (Bonaventure)*.....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

161. Return to an Order of the House of the 4th February, 1914, for a return showing what sum or sums of money, if any, have been expended by the Government since the 21st of September, 1911, in the County of Wright, Quebec, and how such money has been expended. Presented March 2, 1914.—*Mr. Devlin*.....*Not printed.*

162. Return to an Order of the House of the 26th February, 1914, for a return showing:—

1. How many temporary clerks were employed in the Library of Parliament during the Sessions of 1911-1912 and 1912-1913, their names and the salary paid to each for such service, and the total so paid?

2. How many temporary clerks are at present so employed, their names and salaries respectively?

3. If any temporary clerks were employed in said library, during the Session of 1910-1911; if so, how many?

4. What was the then number of permanent clerks in the library, and the present number of temporary clerks employed in said library?

5. Why temporary clerks are employed in said library in positions superior to and at higher pay than that paid to permanent clerks? Presented March 3, 1914.—*Mr. Turgeon*.....*Not printed.*

163. Return to an Address to His Royal Highness the Governor General of the 2nd February, 1914, for a copy of all correspondence, telegrams, memoranda, Orders in Council, instructions to officers, regulations and other papers and documents relating to a change in the regulations governing the fishing of salmon in the St. John River, above tidal water. Presented March 3, 1914.—*Mr. Sinclair*.....*Not printed.*

164. Return to an Order of the House of the 2nd February, 1914, for a copy of all letters, telegrams and correspondence in any way relating to the appointment of men in any way connected with the salmon fishing pond at Margaree during the year 1913. Presented March 3, 1914.—*Mr. Chisholm (Inverness)*.....*Not printed.*

165. Return to an Order of the House of the 2nd February, 1914, for a copy of all tenders received in 1912 for the construction of a breakwater at Green Point, Gloucester County, N.B., and of all correspondence, letters and telegrams showing why the contract was not awarded to lowest tenderer. Presented March 3, 1914.—*Mr. Turgeon*..*Not printed.*

166. Return to an Order of the House of the 2nd February, 1914, for a copy of all correspondence, letters, telegrams, &c., touching in any way the work done on Lingan Beach, South Cape Breton, under Superintendent H. D. McLean. Presented March 3, 1914.—*Mr. Carroll*.....*Not printed.*

167. Return to an Order of the House of the 2nd February, 1914, for a copy of all papers, advertisements, tenders, bids, contracts, reports, vouchers, accounts, receipts, correspondence, &c., in connection with a wharf recently constructed at Gold River, Lunenburg County, N.S. Presented March 3, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

168. Return to an Address to His Royal Highness the Governor General, of the 9th February, 1914, for a copy of all documents, Orders in Council, correspondence, telegrams, tenders, accounts, vouchers, part, &c., in connection with the construction of a bridge or work between the mainland and an island, known as Boutilier's island, at South West Cove, Lunenburg County, N.S. Presented March 3, 1914.—*Mr. Maclean (Halifax)*..*Not printed.*

169. Return to an Order of the House of the 9th February, 1914, for a copy of all advertisements, tenders, contracts, documents, letters and correspondence relating to the supply of coal for the Government public buildings at Lunenburg, N.S. Presented March 3, 1914.—*Mr. Macdonald*.....*Not printed.*

170. Return to an Order of the House of the 2nd February, 1914, for a comparative statement of the quantity of cubic yards of dredging done by the *Restigouche*, or dredge *No. 3*, on the outside bar of Bathurst Harbour, during the seasons of 1910, 1911, 1912 and 1913. Presented March 3, 1914.—*Mr. Turgeon*.....*Not printed.*

170*a*. Return to an Order of the House of the 2nd February, 1914, for a copy of all tenders received for the dredging in Bathurst Harbour, and of the contract awarded. Presented March 3, 1914.—*Mr. Turgeon*.....*Not printed.*

170*b*. Return to an Order of the House of the 2nd February, 1914, for a copy of all correspondence, letters and telegrams relating to the deposit of sand and mud dumped into the southwestern channel by the contractors of dredging in Bathurst Harbour. Presented March 3, 1914.—*Mr. Turgeon*.....*Not printed.*

171. Return to an Address to His Royal Highness the Governor General of the 9th February, 1914, for a copy of all correspondence, telegrams, petitions and memorials received by the Right Honourable R. L. Borden, Premier of Canada, or the Minister of Railways and Canals, from J. A. Gillies, Esq., Sydney, N.S., or from any resident of the County of Richmond, N.S., relative to the purchasing of the Cape Breton Railway by the Government and the building of a line of railway from St. Peters to Sydney and Louisburg, and of replies thereto. Presented March 3, 1914.—*Mr. Kyte*.....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

172. Return to an Order of the House of the 2nd February, 1914, for a return showing:—
1. The names of all proprietors from whom land and property have been expropriated for the purpose of the Halifax Ocean Terminals between Three Mile House and the proposed site of the railway and shipping terminals?
2. The price or amount of damages paid therefor, or the amount offeerd and accepted in the case of each proprietor?
3. The amount offered or tendered each proprietor for damages and which has not been accepted.
4. The quantity of land and nature of property so expropriated from each proprietor. Presented March 3, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

172a. Return to an Order of the House of the 2nd February, 1914, for a copy of all advertisements, tenders, papers, documents, letters and correspondence relating to the construction of the railway from Three Mile House at Bedford Basin to Halifax Harbour, and also to the piers or wharfs and sea walls in connection with the proposed Halifax Ocean Terminals. Presented March 16, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

173. Return to an Order of the House of the 2nd February, 1914, for a copy of all agreements, correspondence, papers and documents referring to any arrangement made between the Intercolonial Railway of Canada and the Canadian Pacific Railway in the year 1913, relating to the hauling of Canadian Pacific Railway freight and passenger trains between St. John and Halifax, connecting with any transatlantic steamship lines at Halifax, during the winter season of 1913-14. Presented March 4, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

174. Return to an Order of the House of the 20th January, 1913, for a copy of all recommendations, correspondence, letters, telegrams and reports now on file in the Department of Justice, relating to the vacancy in the office of deputy warden of the Dorchester penitentiary, and the appointment of a successor to Mr. A. B. Pipes, who was promoted from the position of deputy warden of Dorchester penitentiary to that of warden. Presented March 4, 1914.—*Mr. Emmerson*.....*Not printed.*

175. Correspondence between the City of Ottawa and the Government, on the subject of a pure water supply for the city and Government buildings. Presented by Hon. Mr. Borden, March 4, 1914.....*Not printed.*

176. Return to an Order of the House of the 2nd February, 1914, for a copy of all letters, correspondence, telegrams and all other documents between the Department of Railways and Canals and Archer, Macdonald, E. Montpetit, C. A. Harwood, and A. Marceau, local engineer, St. Amour, Superintendent of the Canal of Soulanges, L. A. Sauvè, and others, respecting the tearing down of several houses and dependencies erected on the Government grounds at Pointe Cascades, the property of the said L. A. Sauvé. Presented March 5, 1914.—*Mr. Boyer*.....*Not printed.*

177. Return to an Order of the House of the 23rd February, 1914, for a copy of all agreements between the Transcontinental Railway Commission and the Canadian Northern Railway for the use of the line of the said company by the trains of the Transcontinental Railway from Cap Rouge to the shops at St. Malo. Presented March 5, 1914.—*Sir Wilfrid Laurier*.....*Not printed.*

178. Return to an Order of the House of the 23rd February, 1914, for a copy of all correspondence between the Minister of Railways or the Transcontinental Railway Commission and the Quebec Harbour Commission, with regard to the construction by the said Harbour Commission of a line of railway to connect the said Transcontinental Railway from Champlain Market with the proposed Union Station at the Palais, and of all contracts by the said Harbour Commission towards that end. Presented March 5, 1914.—*Sir Wilfrid Laurier*.....*Not printed.*

179. Return to an Order of the House of the 9th February, 1914, for a copy of all advertisements, tenders, contracts and correspondence in connection with the proposed New London Branch of the Prince Edward Island Railway. Presented March 5, 1914.—*Mr. Graham*.....*Not printed.*

180. Return to an Order of the House of the 4th February, 1914, for a return showing the total amount of available cash on deposit to the credit of the Government of Canada on the last day of each month between April 1, 1913, and December 31, 1913. Presented March 5, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

181. Return to an Order of the House of the 4th February, 1914, for a return showing the following particulars respectively, of all loans placed or extended by the Government of Canada, upon the London market during the calendar years 1912 and 1913: Loan, date and copy of prospectus; price in prospectus and price realized; date on which loan matures; rate per cent; total issue; amount realized; charges including discount for immediate payments, &c.; net amount of cash realized; and the annual effective rate of interest per unit. Presented March 5, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

182. Return to an Order of the House of the 9th February, 1914, for a return showing the number of farm labourers and public servants respectively, placed by the Government employment agents during the years 1912 and 1913; also the counties where placed and amount of bonus paid. Presented March 6, 1914.—*Mr. Sutherland*.....*Not printed.*

183. Return to an Order of the House of the 26th February, 1914, for a return showing:—

1. What chartered banks in Canada have gone into liquidation since Confederation, and at what date in each case;

2. The loss in each case to the depositors, the note holders and the stockholders respectively;

3. What relief, if any, was given in each case by the Government to any of the parties suffering loss. Presented March 6, 1914.—*Mr. Neely*.....*Not printed.*

184. Return to an Order of the House of the 11th February, 1914, for a return showing the number of binders, reapers, mowers, ploughs, seeders, and cultivators exported from and imported to Canada, with their value respectively, in each of the years 1910, 1911, 1912 and 1913. Presented March 6, 1914.—*Mr. Neely*.....*Not printed.*

185. Return to an Order of the House of the 23rd February, 1914, for a return showing the number of cattle exported from Canada to the United States in the months of October, November and December, 1913, and January, 1914, and for the corresponding months in 1912 and 1913. Presented March 6, 1914.—*Mr. Maclean (Halifax)*....*Not printed.*

186. Return to an Order of the House of the 23rd February, 1914, for a return showing the quantities and varieties of fish exported from Canada to the United States in the months of October, November and December, 1913, and January, 1914, and for the corresponding months in 1912 and 1913. Presented March 6, 1914.—*Mr. Maclean (Halifax)*. *Not printed.*

187. Return to an Order of the House of the 26th February, 1914, for a return showing:—

1. Who were, from incorporation, and who are, the officers and directors of the Grand Trunk Pacific Railway Company;

2. The amount of capital stock of said company, the amount paid up, and who are the holders of such paid up stock, and the amount held, and still held, by each;

3. If this company, or a subsidiary company, has contracted to build any portion of the National Transcontinental Railway; and, if so, the total amount of their contracts for such work;

4. What portion of such contracts or work was sublet, and on such sublet contracts what profit was made by the said company. Presented March 6, 1914.—*Mr. Middlebro.* *Not printed.*

188. Report of the Board of Inquiry appointed to investigate and verify the claims of applicants for Fenian Raid Volunteer Bounty in the Province of Nova Scotia. Presented by Hon. Mr. Hughes, March 9, 1914.....*Not printed.*

188a. List of applicants, in Nova Scotia, for the Fenian Raid Volunteer Bounty whose claims have been approved.—List of Fenian Raid Volunteer Bounty applicants, in Nova Scotia, received to December 31, 1913, but not yet considered. Presented by Hon. Mr. Hughes, March 9, 1914.....*Not printed*

189. Return to an Order of the House of the 12th February, 1914, for a return showing what was the local minimum rate of freight on small parcels on the Intercolonial Railway prior to October 10, 1911, and also the present rate on the same. Presented March 9, 1914.—*Mr. Sinclair* .....*Not printed.*

190. Return to an Order of the House for a copy of all correspondence, reports, evidence taken, and of all other papers in the possession of the Minister of Railways and Canals, relating to the investigation recently held by Mr. Ferguson, M.L.A., concerning the affairs of the Trent Valley Canal. Presented March 9, 1914.—*Mr. Burnham.* *Report only printed for distribution and sessional papers.*

191. Return to an Order of the House of the 16th February, 1914, for a copy of all papers necessary to convey full information as to the charter, outfit and instructions of the *Karluk* and auxiliary vessels; the names, rank, pay and terms of engagement of their officers and crews; and of all communications received from Mr. V. Steffansson, or any other person who has received such a communication, written after the expedition sailed for the Arctic Ocean. Presented March 10, 1914.—*Mr. Oliver*.....*Not printed.*

192. Return to an Order of the House of the 2nd February, 1914, for a return showing the number of towns in the Province of Ontario which have a population larger than the town of Chesley, South Riding of Bruce, which was 1,734, according to the last census; also the number of such towns served by letter boxes on the street. Presented March 10, 1914.—*Mr. McCrancy* .....*Not printed.*

193. Return to an Order of the House of the 2nd February, 1914, for a return showing the names of the promoters of the National Drop Forge Company, Limited, and the powers asked by and given to said company by letters patent. Presented March 10, 1914.—*Mr. Lemieux* .....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

194. Return to an Order of the House of the 2nd February, 1914, for a return showing the names of the promoters of the Canadian Contracting Company, and the powers asked by and given to said company by letters patent. Presented March 10, 1914.—*Mr. Lemieux* ..... *Not printed.*

195. Return to an Order of the House of the 4th February, 1914, for a copy of all papers, letters, telegrams, reports, inquiries and documents or other communications had with any of the Departments of the Government, particularly with the Interior, Customs and Marine and Fisheries Departments, relating to Gustavas A. Colpitts, a Canadian citizen returning as a passenger on the Royal Mail Steamship *Empress of Britain*, in September, 1911, who alleged that he was not allowed by officers of the Government to disembark at Rimouski from said steamship. Also a copy of all letters, correspondence or other communications received by any members of the Government, particularly by the Minister of Marine and Fisheries, and by any Department of the Government, from the said Gustavas A. Colpitts, who was at the time a student at Mount Allison University, Sackville, New Brunswick, and of all letters or other communications sent in reply thereto. Presented March 10, 1914.—*Mr. Emmerson*..... *Not printed.*

196. Number of Chinamen entering Canada during years 1911-12-13, &c.—(*Senate.*). *Not printed.*

197. Return to an Order of the House of the 23rd February, 1914, for a copy of all letters, papers, plans, correspondence, memoranda and other documents relative to the shortening of distances on the Intercolonial Railway between Pictou and Port Mulgrave, and to the construction of a new bridge at Pictou in connection therewith. Presented March 12, 1914.—*Mr. Macdonald*..... *Not printed.*

198. Return to an Order of the House of the 23rd February, 1914, for a copy of all letters, telegrams, correspondence, leases and other documents relating to the cutting of lumber by Mr. B. F. Smith from the so-called Tobique Indian reserve, in the Province of New Brunswick, and of all recommendations with reference thereto, made by the Indian agent for that portion of the Province, or any other official of the Department in the said Province; together with a statement of the lumber cut by said Smith from said reserve, with the rates of stumpage charged and amounts paid since January 1, 1912. Presented March 12, 1914.—*Mr. Carvell*..... *Not printed.*

198*a*. Return to an Order of the House of the 23rd February, 1914, for a copy of all correspondence, letters, telegrams, memorials, petitions, &c., relating to the sale or transfer of the Indian reserve at Sydney, N.S., and the removal of the Indians therefrom. Presented March 17, 1914.—*Mr. Kyte*..... *Not printed.*

198*b*. Return to an Order of the House of the 23rd March, 1914, for a copy of all the instructions issued to C. P. Fullerton and Fawcett Taylor, or either of them, in reference to the St. Peter's Indian reserve. Presented April 8, 1914.—*Mr. Oliver*..... *Not printed.*

199. Return to an Order of the House of the 11th February, 1914, for a copy of all correspondence, letters, telegrams and other documents relative to the purchase for the Intercolonial Railway of a quantity of coal in the United States, within the past few months. Presented March 12, 1914.—*Mr. Macdonald* ..... *Not printed.*

199*a*. Return to an Order of the House of the 2nd February, 1914, for a return showing:—

1. When the Intercolonial Railway and the Prince Edward Island Railway last called for tenders for its coal supply, and when the tenders were returnable?

2. The number of tenders received, the names of the tenderers, and their respective prices?

3. The date of the last contract or contracts for coal for the Intercolonial Railway, and who was the contractor or contractors respectively?

4. The names of the successful tenderers, as the result of the last call for tenders, and their prices respectively?

5. The amount in tons of the contract made with each, and at what prices per ton respectively?

6. If any coal was purchased for the Government system of railways in the United States since March 31, 1913? If so, by whom, from whom, and through whom it was purchased, and at what price, the cost per ton delivered, inclusive of commissions to the railways. Presented March 18, 1914.—*Mr. Emmerson*..... *Not printed.*

199*b*. Return to an Order of the House for a return showing whether the Government has purchased any coal, freight or passenger cars during the past six months for the Intercolonial Railway; if so, from whom and in what quantity; the price paid in each case; if any tenders were called for the same; who the tenderers were and the amount of each tender. Presented April 6, 1914.—*Mr. Macdonald*..... *Not printed.*

200. Return to an Order of the House of the 4th March, 1914, for a return showing the freight rates on flour, hay, oats, lumber and firewood per 100 lbs. or per ton, between Bathurst, N.B., and Nepisiguit Junction, Red Pine, Bartibogue, Beaver Brook, and between Bathurst, Berresford, Petit Rocher and Belledune, before the changes made in August, 1913, and the freight rates on the same articles, between the same points, under the new schedule of rates. Presented March 16, 1914.—*Mr. Turgeon*..... *Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

201. Return to an Order of the House of the 11th February, 1914. for a copy of all contracts, accounts, bills, memoranda, letters, correspondence, receipts, vouchers, bills of lading, &c., referring to all materials, provisions, supplies and goods of every description purchased and forwarded to Port Nelson during the year 1913, by any Department of the Government of Canada, and agreements for employment of workmen in connection with the construction of the Hudson Bay Railway terminals at Port Nelson. Presented March 18, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

202. Return to an Order of the House of the 9th February, 1914, for a copy of all papers, letters or other correspondence, instructions, reports, valuations, appointment of valuators, or appraisers, appraisements, abstracts of titles, deeds or other conveyances, in any Department of the Government or in the railway offices at Moncton, relating to, or in any manner connected with, the purchase by the Intercolonial Railway of a property in Moncton, N.B., at the corner of Archibald and Main streets in said city, formerly owned in his lifetime by the late P. S. Archibald, C.E., and now occupied by the General Superintendent of the Intercolonial Railway, F. P. Brady, as a residence; together with a copy of all bills, accounts and statement of expenditures for repairs made on the buildings of said property; and also of accounts, commissions and bills paid to solicitors, attorneys or other agents, for searches, conveyances, and a statement of all moneys paid for charges and expenses in connection with such purchase or the procuring of a deed of said property? Presented March 16, 1914.—*Mr. Emmerson.*
Not printed.

202*a*. Supplementary Return to an Order of the House of the 9th February, 1914, for a copy of all papers, letters or other correspondence, instructions, reports, valuations, appointment of valuators, or appraisers, appraisements, abstracts of titles, deeds or other conveyances in any department of the Government or in the railway offices at Moncton, relating to, or in any manner connected with, the purchase by the Intercolonial Railway of a property in Moncton, N.B., at the corner of Archibald and Main streets in said city, formerly owned in his lifetime by the late P. S. Archibald, C.E., and now occupied by the General Superintendent of the Intercolonial Railway, F. P. Brady, as a residence; together with a copy of all bills, accounts and statement of expenditures for repairs made on the buildings of said property; and also of accounts, commissions and bills paid to solicitors, attorneys or other agents, for searches, conveyances, and a statement of all monies paid for charges and expenses in connection with such purchase or the procuring of a deed of said property. Presented March 26, 1914.—*Mr. Emmerson*.....*Not printed.*

202*b*. Further Supplementary Return to an Order of the House of the 9th February, 1914, for a copy of all papers, letters or other correspondence, instructions, reports, valuations, appointment of valuators, or appraisers, appraisements, abstracts of titles, deeds or other conveyances in any department of the Government or in the railway offices at Moncton, relating to, or in any manner connected with, the purchase by the Intercolonial Railway of a property in Moncton, N.B., at the corner of Archibald and Main streets in said city, formerly owned in his lifetime by the late P. S Archibald, C.E., and now occupied by the General Superintendent of the Intercolonial Railway, F. P. Brady, as a residence; together with a copy of all bills, accounts and statement of expenditures for repairs made on the buildings of said property; and also of accounts, commissions and bills paid to solicitors, attorneys or other agents, for searches, conveyances, and a statement of all monies paid for charges and expenses in connection with such purchase or the procuring of a deed of said property. Presented April 1, 1914.—*Mr. Emmerson*.....*Not printed.*

203. Return to an Order of the House of the 4th March, 1914, for a return showing the freight rates under the old tariff of the Intercolonial Railway, per 100 lbs. or per ton, on fresh, dried and cured fish, molasses, coal oil, nails, hardware and anthracite coal from Gloucester Junction and Bathurst station to and from St. John, and the present rates for the same articles between the same points. Presented March 17, 1914.—*Mr. Turgeon.*
Not printed.

204. Return to an Order of the House of the 23rd February, 1914, for a return showing all smelt fishing licenses issued in the County of Pictou during the past season, and of all correspondence in reference to the same. Presented March 17, 1914.—*Mr. Macdonald.*
Not printed.

204*a*. Supplementary Return to an Order of the House of the 23rd February, 1914, for a return showing all smelt fishing licenses issued in the County of Pictou during the past season, and of all correspondence in reference to the same. Presented April 17, 1914.—*Mr. Macdonald*.....*Not printed.*

205. Return to an Order of the House of the 2nd February, 1914, for a copy of all documents concerning the latest changes in the lobster fishing regulations at Magdalen Islands. Presented March 17, 1914.—*Mr. Lemieux*.....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

206. Return to an Order of the House of the 16th February, 1914, for a copy of all correspondence, telegrams, tenders and documents connected in any way with the supplying of coal to the lobster hatchery at Margaree during the years 1910-1911, 1911-1912, 1912-1913 and 1913-1914. Presented March 17, 1914.—*Mr. Chisholm (Antigonish).* *Not printed.*

207. Return to an Order of the House of the 16th February, 1914, for a copy of the charges made against Mrs. Marguerite Fair, postmistress of Black Cape, Quebec, on which Mr. Louis Taché of Rimouski, was authorized to hold an investigation, together with the appeal of said investigation, if any was held. Presented March 17, 1914.—*Mr. Marcil (Bonaventure)* ..... *Not printed.*

208. Return to an Order of the House of the 2nd February, 1914, for a copy of all correspondence, papers, documents, reports, &c., in connection with the proposed increase of mail service from Shelburne, N.S., to Jordan Bay and Jordan Ferry and return since October 1, 1911. Presented March 17, 1914.—*Mr. Maclean (Halifax)*..... *Not printed.*

209. Return to an Order of the House of the 2nd February, 1914, for a copy of all correspondence between the Post Office Department, or any official thereof, and any person or persons, concerning the installation of street letter boxes in the village of Chesley, in the riding of South Bruce. Presented March 17, 1912.—*Mr. Graham*....*Not printed.*

210. Report of the Commission of Conservation of Canada on the Trent Watershed Survey, a reconnaissance by C. D. Howe, Ph.D., and J. H. White, B.A., B.Sc. F., with an introductory discussion by B E. Fernow, LL.D Presented by Hon. Mr. Borden, March 19, 1914 ..... *Not printed.*

210a. Conservation of coal in Canada. Report of Commission of Conservation.—(*Senate*). *Not printed.*

211. Copy of evidence taken before Mr. William Henry Moore, the commissioner appointed to inquire into certain charges against Mr. Frank Fairen, store keeper on the Trent Canal, sentation in the Senate, of the Western provinces of Canada. Presented by Hon. Mr. March 19, 1914 ..... *Not printed.*

212. Copy of the opinion of the Deputy Minister of Justice on the subject of increased representation in the Senate, of ahe Western provinces of Canada. Presented by Hon. Mr. Borden, March 19, 1914 ..... *Not printed.*

212a. Copy of a resolution of the Legislative Assembly of the Province of British Columbia, approved by His Honour the Lieutenant Governor in Council, in which application is made to the Federal Government to increase the number of senators for the said province. Presented by Hon. Mr. Borden, March 19, 1914..... *Not printed.*

212b. Copy of opinion of the Assistant Deputy Minister of Justice on the subject of increased representation in the Senate, of the prairie provinces of Canada. Presented by Hon. Mr. Borden, March 23, 1914..... *Not printed.*

213. Return to an Order of the House of the 9th March, 1914, for a copy of all papers and correspondence in the Department of Customs regarding the entry of a boring mill at Lethbridge, Alberta, shipped in August, 1913, by John Stirk and Company, and billed to the Lethbridge Iron Works. Presented March 20, 1914.—*Mr. Buchanan* . *Not printed.*

214. Return to an Order of the House of the 16th March, 1914, for a copy of a petition dated the 9th of July, 1911, signed by Etienne Barre, Joseph Trudeau and others, taxpayers of the municipality of Chambly Basin, and addressed to the Minister of Justice, together with a copy of all documents and vouchers attached to said petition, and of all correspondence and other documents relating thereto. Presented March 23, 1914.—*Mr. Lamarche* ..... *Not printed.*

215. Return to an Order of the House of the 2nd February, 1914, for a return showing where the D.G. cruiser *Margaret* was built; the names of the builders; the contract price; whether the contract was awarded to the lowest tenderer; the name and address of each tenderer and amount of each tender; if the Government or any department thereof has contracted for any other vessel or vessels during the past eighteen months; and if so, the number of such vessels, the names and addresses of the contractors, the gross tonnage of each and the contract price, and the service for which they were intended. Presented March 23, 1914.—*Mr. Sinclair*..... *Not printed.*

216. Return to an Order of the House of the 2nd March, 1914, for a copy of all letters, telegrams or other correspondence in connection with the seizure of eleven (11) horses belonging to Mr. John M. Ferguson, Kaleida, Manitoba, on or about the 28th day of March, 1912. Presented March 24, 1914.—*Mr. Turriff*..... *Not printed.*

217. Return to an Order of the House of the 4th February, 1914, for a return showing the quantities and values of potatoes imported monthly into Canada during the years 1911, 1912 and 1913, and the countries from which such potatoes were imported. Presented March 25, 1914.—*Mr. Hughes (Kings, P.E.I.)*..... *Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

217a. Return to an Order of the House of the 2nd February, 1914, for a return showing the quantities and values of potatoes exported monthly from each province of Canada, from September 1, 1911, to January 1, 1914, and the countries to which the same were exported. Presented March 25, 1914.—*Mr. Carvell* .....*Not printed.*

218. Return to an Order of the House of the 12th March, 1914, for a return showing how many colonels, honorary colonels, lieut.-colonels, honorary lieut.-colonels, and other officers, honorary and otherwise, have been appointed by the Minister of Militia and Defence from October, 1911, to the present time. Presented March 25, 1914.—*Mr. Hughes (Kings, P.E.I.)*.....*Not printed.*

218a. Return to an Order of the House of the 11th February, 1914, for a return showing the number of honourary appointments to military rank which have been made by, or with the approval of, the present Minister of Militia and Defence since he assumed office, giving the names of the persons so appointed, and the rank of each. Presented April 1, 1914.—*Mr. Murphy* .....*Not printed.*

219. Kitsilano Indian reserve—relating to the purchase of by the Government of the Dominion of Canada from the Province of British Columbia.—(*Senate*).....*Not printed.*

220. Return to an Address to His Royal Highness the Governor General of the 9th March, 1914, for a copy of all papers, documents, Orders in Council, correspondence, &c., in reference to the suspension of Mr. Joseph McGillis of the Department of Customs, Ottawa. Presented March 27, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

221. Return to an Order of the House of the 2nd February, 1914, for a return showing the names of all parties who have been employed at the Experimental Farm at Ste. Anne de la Pocatière during the years 1912 and 1913, and the salary and fees paid to each of them. Presented March 30, 1914.—*Mr. Lapointe (Kamouraska)*.....*Not printed.*

222. Return to an Order of the House of the 9th February, 1914, for a return showing the total number of veterinary inspectors employed by the Government in the slaughter houses of the country; how they are distributed in each Province; the names of the establishments they are connected with, and the number of officers in each of them; if the Government employ some others to supervise the health of the herds on the farms besides the veterinary inspectors connected with the slaughter houses; the number of them, and how they are distributed in each Province; the number of herds of both cattle and hogs that have been submitted to inspection during the years 1911, 1912 and 1913; the number of animals in each Province slaughtered ,after tuberculosis was found in them; if the Government paid indemnities to the owners on account of such slaughtering, and if so, the amount in each Province; the respective salaries of the veterinary inspectors employed in the slaughter houses; the working hours of those officers; the respective salaries paid to the veterinary inspectors employed for other purposes; the amount of the expenses of that branch of the Department of Agriculture for the years 1911, 1912 and 1913 for internal managmeent, such as salaries, and the salaries and expenses for each of the Provinces. Presented March 30, 1914.—*Mr. Boyer.* *Not printed.*

223. Return to an Order of the House of the 23rd February, 1914, for a copy of the report of George Lafontaine, received by the Department of Agriculture during the present fiscal year, relating to the manufacture of chemical manure. Presented March 30, 1914.—*Mr. Boulay* .....*Not printed.*

224. Return to an Order of the House of the 16th February, 1914, for a return showing.—

1. Whether the Postmaster General has given a contract for rural parcel boxes; and, if so, to whom?
2. Whether tenders for the boxes were asked?
3. From whom tenders were received?
4. The price, if any, of the different tenders?
5. How many boxes were ordered, and at what price?
6. Whether the Postmaster General, since he came into office, has made a contract for rural mail boxes, and, if so, when?
7. The amount of the contract?
8. Who the tenderers were, and the price, if any, of the different tenders?
9. Who received the contract, and the price paid per box?
10. How many boxes, if any, were ordered? Presented March 31, 1914.—*Mr. Nesbitt* ..... *Not printed.*

225. Return to an Order of the House of the 23rd March, 1914, for a return showing the rates of interest paid on all Dominion loans from 1890 to 1914. Presented March 31, 1914.—*Mr. Pardee*.....*Not printed.*

226. Return to an Address to His Royal Highness the Governor General, of the 9th March, 1914, for a copy of all correspondence since October, 1911, between the Government of Canada, represented by the Department of Marine and Fisheries, of the one part, and the Goverment of the United Kingdom, the Government of the United States, or any other Government, of the other part, relating to steam trawling in Atlantic waters. Presented March 31, 1914.—*Mr. Sinclair*.....*Not printed.*

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227. Return to an Order of the House of the 11th February, 1914, for a copy of all letters, telegrams, and written requests during the years 1912 and 1913, addressed to the Department of Marine and Fisheries, or the Department of Naval Affairs, or any officer of either Department, or Marine branches of said department, or any officer or persons of either branch, by any person or persons, relating to proposals or requests that the vessels or any vessel under the control of the Naval Branch of said Department, should be present at any regatta or celebration of any description held anywhere on the Atlantic or Pacific Coasts of Canada during said years; also of all replies to such letters, telegrams and written requests. Presented March 31, 1914.—*Mr. Law* ..... *Not printed.*

228. Return to an Order of the House of the 9th March, 1914, for a copy of all correspondence, memoranda and other documents relating to the moral, mental and physical inspection of all immigrants entering Canada. Presented April 1, 1914.—*Mr. Paquet.* *Not printed.*

229. Return to an Order of the House of the 16th March, 1914, for a copy of all orders, reports, applications, letters, telegrams and other documents connected with or in any manner relating to the retirement of Amasa E. Killam, an official of the Intercolonial Railway, from the employment of the said railway, and to his claim for a retiring allowance, under the provisions of the Intercolonial and Prince Edward Island Railway Employees' Provident Fund Act; and also of all letters showing the date of his beginning work in the service of the said railway and of his appointment to a position in the employ of said railway on the first of April, 1897, or at any other date. Also a copy of all instructions and letters from the then Minister of Railways to the general manager or to any other official of the Intercolonial, relating to engagement or employment of the said Amasa E. Killam, and of all letters, correspondence, instructions, reports, or other documents in any way relating thereto and to the engagement of the said Amasa E. Killam, during the month of March, 1897, to take the position of bridge and building inspector on the Intercolonial Railway, to commence work on the first day of April, 1897. Presented April 1, 1914.—*Mr. Emmerson*...*Not printed.*

230. Return to an Order of the House of the 23rd February, 1914, for a copy of all letters, papers and other documents relating to the payments made at Skinners Cove, Pictou County, for purchase of land or other rights in the year 1913. Presented April 2, 1914.—*Mr. Macdonald* ..... *Not printed.*

231. Return to an Order of the House of the 2nd February, 1914, for a copy of all papers, correspondence, telegrams, letters, pay rolls, accounts and vouchers in any way referring to the expenditure of money by this Government for the public wharf at Whycocomagh. Presented April 2, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

231*a*. Return to an Order of the House of the 2nd February, 1914, for a copy of all papers, advertisements, tenders, bids, contracts, reports, vouchers, accounts, receipts, correspondence, &c., in connection with the construction of a wharf at Feltzen South, Lunenburg County, N.S., now under construction or recently completed. Presented April 2, 1914.—*Mr. Chisholm (Inverness)*.....*Not printed.*

231*b*. Return to an Order of the House of the 4th March, 1914, for a return showing:—

1. How much money was expended on the repairs to the wharf at South Gut, Victoria County, during the summer of 1913?
2. How much on labour and how much on material, respectively?
3. Who was the foreman, by whom recommended, and his rate of wages per day?
4. How many days he was employed as foreman?
5. How many men he had working for him on the wharf each day, and the wages paid each man?
6. How much was paid for material for the repairs, and where it was obtained?
7. From whom the material was purchased, the nature of it, and the price paid per foot?
8. Who was the paymaster on this work and when the men were paid? Presented April 2, 1914.—*Mr. McKenzie*.....*Not printed.*

231*c*. Return to an Order of the House of the 9th February, 1914, for a return showing the amount expended by the Government on wharfs, breakwaters, public works and dredging in the County of Yarmouth since October 11, 1911; and to whom the amounts so expended were paid. Presented April 2, 1914.—*Mr. Law*....*Not printed.*

231*d*. Return to an Order of the House of the 4th March, 1914, for a return showing:—

1. How much money was expended on repairs to the Englishtown wharf, County of Victoria, in the summer of 1913?
2. How much on labour and how much on material, respectively?
3. Who was the foreman, by whom he was recommended, and his rate of wages per day?
4. How many days he was employed as foreman?
5. How many men he had working for him on the wharf each day, and the wages paid each man?

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6. From whom the material was purchased, of what it consisted, and the price paid per foot?

7. Who was the paymaster on this work, and when the men were paid?

8. When the work was begun and when completed? Presented April 2, 1914.—*Mr. McKenzie* ..... *Not printed.*

231e. Return to an Order of the House of the 16th February, 1913, for a copy of all letters, telegrams, correspondence, pay-rolls, vouchers and documents of all kinds connected in any way with repairs or extension of wharf at Finlay Point, Mabou, Inverness County, during the year 1910-1911. Presented April 2, 1914.—*Mr. Chisholm (Inverness)* ..... *Not printed.*

231f. Return to an Order of the House of the 4th March, 1914, for a return showing the amount of timber used and the price paid for same in renewing and repairing the wharf at Port Clyde, Shelbourne County, N.S.; the amount of wages paid on same, and to whom; and the number and price of ballast poles used in the above work. Presented April 2, 1914.—*Mr. Law* ..... *Not printed.*

231g. Return to an Order of the House of the 12th May, 1913, for a copy of all papers, telegrams, documents, reports, correspondence, &c., in any way relating to a proposed extension of a wharf or the construction of a new wharf at Finlay Point, Inverness County, N.S. Presented April 2, 1914.—*Mr. Chisholm (Inverness)* ..... *Not printed.*

231h. Return to an Order of the House of the 26th May, 1913, for a copy of all papers, letters and documents relating to the building of a wharf in the town of L'Assomption. Presented April 2, 1914.—*Mr. Seguin* ..... *Not printed.*

231i. Return to an Address of the 19th May, 1913, to His Excellency the Administrator for a copy of all papers, tenders, contracts, accounts, and Orders in Council, between the Department of Public Works and any other person or persons, relating to the purchase of a site for the public wharf being erected or recently erected at Bear River, N.S., and also relating to the construction of said wharf, and anything in connection therewith. Presented April 2, 1914.—*Mr. Maclean (Halifax)* ..... *Not printed.*

231j. Return to an Order of the House of the 31st March, 1913, for a copy of all papers, documents, correspondence, &c., relating to the purchase of a property at Centreville, Shelburne County, Nova Scotia, as a site for a public wharf, and in connection with any monies expended on the McGray property at Centreville, upon the public wharf. Presented April 2, 1914.—*Mr. Kyte* ..... *Not printed.*

231k. Return to an Order of the House of the 9th March, 1914, for a copy of all correspondence, letters, telegrams, notes, requests, &c., addressed to the Department or the Minister of Public Works, directly or indirectly, in connection with the work necessary for the completion of the wharf at Sainte Croix, County of Lotbinière, since the 21st of September, 1911, to date. Presented April 16, 1914.—*Mr. Fortier* ..... *Not printed.*

231l. Return to an Order of the House of the 2nd February, 1914, for a copy of all correspondence, petitions, memorials, letters, reports, and telegrams, in the Department of Public Works, or in any of the Departments of the Government, relating to a proposed wharf or breakwater at Little Cape, and Great Shemogue Harbour, Westmorland County, N.B.; also of all correspondence, letters and telegrams exchanged between any member of the Government and M. G. Siddal, or any other persons or corporations, relating to a proposal or application to construct a wharf or breakwater at Little Cape or Great Shemogue Harbour in Westmorland County, N.B., or in connection with having a survey made in connection with any such proposal. Presented April 17, 1914.—*Mr. Emmerson* ..... *Not printed.*

231m. Return to an Order of the House of the 9th February, 1914, for a copy of all reports, memoranda, correspondence and documents of every nature, relating to the construction of a wharf in the town of L'Assomption, and of all petitions and correspondence in favour or against such construction to date, and the reasons why the construction of such wharf, authorized in the estimates of 1911-1912, has not been proceeded with. Presented April 17, 1914.—*Mr. Seguin* ..... *Not printed.*

231n. Return to an Order of the House of the 16th March, 1914, for a copy of all accounts, vouchers, pay-rolls, instructions, correspondence and recommendations relating to the expenditure on the public wharf at Arichat, N.S., since the 11th day of October, 1911. Presented April 30, 1914.—*Mr. Kyte* ..... *Not printed.*

231o. Return to an Order of the House of the 16th February, 1914, for a copy of all tenders, contracts, memorandums, pay-rolls, accounts, vouchers, correspondence, papers and documents, &c., in connection with work performed upon the Government wharf at Croft's Cove, Lunenburg County, in 1912. Presented April 30, 1914.—*Mr. Maclean (Halifax)* ..... *Not printed.*

231p. Return to an Order of the House of the 9th March, 1914, for a copy of all correspondence, letters, telegrams, petitions and other documents relating to the claim of the Bonaventure and Gloucester Interprovincial Company, Limited, in connection wtih a wharf on Bonaventure river, Bonaventure County. Presented April 30, 1914.—*Mr. Sevigny.* *Not printed.*

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231*q*. Supplementary Return to an Order of the House of the 9th March, 1914, for a copy of all correspondence, letters, telegrams, notes, requests, &c., addressed to the Department or the Minister of Public Works, directly or indirectly, in connection with the work necessary for the completion of the wharf at Sainte Croix, County of Lotbinière, since the 21st September, 1911, to date. Presented April 30, 1914.—*Mr. Fortier*.....*Not printed.*

231*r*. Return to an Order of the House of the 2nd February, 1914, for a copy of all tenders, contracts, pay rolls, vouchers, documents, correspondence, &c., in connection with the purchase of a site for the Government wharf at Bear River, N.S., and the construction of the said wharf. Presented April 30, 1914.—*Mr. Maclean (Halifax)*..*Not printed.*

231*s*. Return to an Order of the House of the 9th March, 1914, for a return showing:—

1. How much was spent upon Hall's Harbour wharf, Kings County, N.S., in 1913?

2. The name of the commissioner or foreman, by whom he was recommended, and his remuneration?

3. How much lumber was used upon the said wharf during 1913, from whom the same was purchased, and the price paid for the various forms thereof. Presented April 30, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

231*t*. Return to an Order of the House of the 16th February, 1914, for a copy of the pay-list, including the names and residences, of all those who have worked at the wharf of L'Ile Verte, County of Témiscouata; the number of days of employment of each of them; the amount received by each of them; who has or have signed the receipt or receipts for said amounts, in connection with the works which have been going on during the summer of 1912 and during the summer of 1913. Presented April 30, 1914.—*Mr. Gauvreau* .....*Not printed.*

231*u*. Return to an Order of the House of the 16th February, 1914, for a copy of the pay-list, including the names and residences, of the men who have worked on the wharf to the west of Rivière-Verte, Témiscouata; the number of days' work of each of them; the amount of money received by each of them; who has or have signed the receipt or receipts for said amounts on said pay-list or otherwise, the whole for: (1o) 1912; (2o) 1913. Presented May 4, 1914.—*Mr. Gauvreau*.....*Not printed.*

231*v*. Further Supplementary Return to an Order of the House of the 9th Mrach, 1914, for a copy of all correspondence letters, telegrams, notes, requests, &c., addressed to the Department or the Minister of Public Works, directly or indirectly, in connection with the work necessary for the completion of the wharf at Sainte Croix, County of Lotbinière, since the 21st of September, 1911, to date. Presented May 4, 1914.—*Mr. Fortier* .....*Not printed.*

231*w*. Return to an Order of the House of the 30th March, 1914, for a copy of all letters and telegrams addressed by G. A. R. Rowlings and J. S. Wells to the Department of Public Works, or the Minister, since October 1, 1911, relating to the construction of a public wharf at Cole Harbour, Guysborough County, N.S., and of all replies thereto. Presented May 12, 1914.—*Mr. Sinclair*.....*Not printed.*

231*x*. Return to an Order of the House of the 16th February, 1914, for a copy of all letters, telegrams and correspondence of all kinds in any way relating to repairs required on the pier at Margaree Harbour, Inverness County, received in 1912-1913 and 1913-1914. Presented May 12, 1914.—*Mr. Chisholm (Inverness)* .....*Not printed.*

231*y*. Return to an Order of the House of the 27th April, 1914, for a copy of all correspondence, pay-rolls, accounts, receipts, vouchers and papers relating to the construction of Feltzen South wharf, Lunenburg County, N.S. Presented May 16, 1914.—*Mr. Maclean (Halifax)* .....*Not printed.*

231*z*. Return to an Order of the House of the 2nd February, 1914, for a copy of all papers, correspondence, telegrams, letters, pay-rolls, accounts and vouchers in any way referring to the expenditure of money by this Government for the building and repair of the public wharf at Port Hood. Presented May 16, 1914.—*Mr. Chisholm (Inverness)* *Not printed.*

231 (2*a*). Return to an Order of the House of the 4th May, 1914, for a copy of all correspondence, telegrams, complaints, pay-rolls, vouchers and all other documents in any way connected with the expenditure of $500 during the year 1913 on Finlay Point wharf, Inverness County. Presented May 16, 1914.—*Mr. Chisholm (Inverness)*..*Not printed.*

231 (2*b*). Return to an Order of the House of the 6th April, 1914, for a copy of all correspondence, letters, telegrams, petitions and recommendations relating to the wharf at Arichat, N.S., to be used by SS. *Magdalin*. Presented May 29, 1914.—*Mr. Kyte*....*Not printed.*

231 (2*c*). Return to an Order of the House of the 9th March, 1914, for a return showing:—

1. How much money was spent upon Kingsport Pier, Kings County, N.S., during the year 1913?

2. The name of the foreman or commissioner, by whom he was recommended, and the remuneration paid him?

3. How much lumber was purchased and used for said pier, from whom it was purchased, and the particulars of the prices paid therefor?

4. What was done with the lumber or piling taken out of said pier, and if the same was sold, to whom and at what price? Presented May 29, 1914.—*Mr. Maclean (Halifax)* .....*Not printed.*

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231 (*2d*). Return to an Order of the House of the 27th April, 1914, for a copy of all correspondence, pay-rolls, accounts, receipts, vouchers and papers relating to the construction of Kraut Point wharf, Lunenburg County, N.S. Presented June 12, 1914.—*Mr. Maclean (Halifax)* ..... *Not printed.*

232. Return to an Order of the House of the 4th March, 1914, for a return showing:—

1. How much money has been expended in public works in the Counties of Rimouski and Gaspé, respectively, since October 11, 1911.

2. How much of the money so expended was provided for in the estimates of 1911-1912?

3. What amount was expended on the works for which money was not included in the estimates of 1911-1912? Presented April 2, 1914.—*Mr. Marcil (Bonaventure).* *Not printed.*

232*a*. Return to an Order of the House of the 23rd February, 1914, for a return showing how much money has been expended on public works in Antigonish County since October 11, 1911.

2. How much of the amount so expended was provided in the estimates for 1911-1912?

3. What amount, not included in the estimates for 1911-1912, was expended on public works in said county? Presented April 2, 1914.—*Mr. Chisholm (Antigonish).*

232*b*. Return to an Order of the House of the 9th February, 1914, for a copy of all papers, reports, documents, correspondence, plans, &c., in reference to a proposed Government public building at Bear River, N.S., and the purchase of a site for the same. Presented April 2, 1914.—*Mr. Maclean (Halifax)* ..... *Not printed.*

232*c*. Return to an Order of the House of the 9th April, 1913, for a copy of all charges, correspondence, pay-rolls, telegrams and other documents relating in any way to the expenditure of money on the harbour improvements at Mabou Harbour by the Department of Public Works, during the years 1911-12, 1912-13. Presented April 2, 1914.—*Mr. Chisholm (Inverness)* ..... *Not printed.*

232*d*. Return to an Order of the House of the 28th May, 1913, was issued to the proper officer for a copy of the specifications and tenders for materials to be used in connection with the proposed dry dock at Lauzon, Quebec. Presented April 2, 1914.—*Mr. Lemieux.* *Not printed.*

232*e*. Return to an Order of the House of the 3rd March, 1913, for a copy of all documents, letters, reports of engineers and statements of detailed expenditure in connection with dredging at Bonaventure River, Quebec. Presented April 2, 1914.—*Mr. Marcil (Bonaventure)* ..... *Not printed.*

232*f*. Return to an Order of the House of the 3rd March, 1913, for a copy of all petitions, correspondence, reports or other papers or documents in the Department of Public Works relating to the building of a breakwater at Goulman's Point, Half Island Cove, Guysboro' County, N.S. Presented April 2, 1914.—*Mr. Sinclair* ..... *Not printed.*

232*g*. Return to an Order of the House of the 16th February, 1914, for a copy of all letters, telegrams, correspondence and documents of all kinds in any way relating to a lighthouse to be built at Red Cape, Margaree Harbour, Inverness County. Presented April 7, 1914.—*Mr. Chisholm (Inverness)* ..... *Not printed.*

232*h*. Return to an Order of the House of the 2nd February, 1914, for a copy of all papers, documents, telegrams, correspondence, &c., in reference to the purchase of a site in Saskatoon for a post office building. Presented April 16, 1914.—*Mr. McCraney.* *Not printed.*

232*i*. Return to an Order of the House of the 9th February, 1914, for a copy of all correspondence, reports, petitions and documents exchanged by and with the Department of Public Works since the 1st of September, 1911, to date, with the reasons why the construction of the public building, authorized in the town of St. Lin Des Laurentides, County of L'Assomption, as per the estimates of 1911-1912, has not been proceeded with. Presented April 17, 1914.—*Mr. Seguin* ..... *Not printed.*

232*j*. Return to an Order of the House of the 2nd February, 1914, for all correspondence, reports and documents exchanged by and with the Department of Public Works from October, 1911, to date, regarding the non-erection of the public building authorized to be erected at New Carlisle, the county seat of Bonaventure County, in the estimates of 1911-1912. Presented April 17, 1914.—*Mr. Marcil (Bonaventure)* ..... *Not printed.*

232*k*. Return to an Order of the House of the 2nd February, 1914, for a return showing the names of all persons who worked on Lingan Bar, South Cape Breton, under Superintendent H. D. McLean, the wages paid to each per diem, the amount paid each or payable to each, and showing generally how the amount voted for such work was expended, and the amount received by H. D. McLean in connection with said work. Presented April 17, 1914.—*Mr. Carroll* ..... *Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

232*l*. Return to an Order of the House of the 2nd February, 1914, for a copy of all papers, advertisements, tenders, contracts, papers, telegrams, correspondence, returns, reports, accounts, vouchers, receipts, &c., in connection with any dredging performed by the Nova Scotia Dredging Company, or any other company, corporation or individuals, at Jeddore, Halifax County, N.S., in the years 1912 and 1913. Presented April 17, 1914. —*Mr. Maclean (Halifax)*.....*Not printed.*

232*m*. Return to an Order of the House of the 12th May, 1913, for a copy of all papers, telegrams, documents, reports, correspondence, pay-rolls, &c., in any way relating to a life-saving station which was constructed at Cheticamp, during 1912. Presented April 28, 1914.—*Mr. Chisholm (Inverness)*.....*Not printed.*

232*n*. Return to an Order of the House of the 12th March, 1914, for a return showing:—

1. What firms or persons are or have been engaged in dredging for the Government in the harbour of St. John and upon the St. John river and its tributaries since October 1, 1911.

2. What amount has been paid to each firm or person for this work from October 1, 1911, to the present time?

3. Who are the officers, president, manager and secretary of each of these corporations? Presented April 30, 1914.—*Mr. Carvell*.....*Not printed.*

232*o*. Return to an Order of the House of the 16th February, 1914, for a copy of all documents bearing on the repairing and improvement of the Metapedia Road in the Counties of Rimouski and Bonaventure. Presented April 30, 1914.—*Mr. Marcil (Bonaventure)*. *Not printed.*

232*p*. Return to an Order of the House of the 12th March, 1914, for a return showing:—

1. What tug boats, steam or gasoline tenders, have been employed by the Government since September 21, 1911, in connection with the dredging operations in St. John harbour and in the River St. John and its tributaries?

2. Who are the registered owners of these boats and from whom each is hired?

3. The sum paid per day for each tug boat or tender and how many days each has worked in the period referred to.

4. What amount of money has been paid for the service of each boat in the period referred to and to whom it has been paid. Presented April 30, 1914.—*Mr. Carvell.* *Not printed.*

232*q*. Return to an Order of the House of the 9th March, 1914, for a return showing the details as to the nature of the work concerning the damming of the Chateauguay river, the number of men employed, their names, the wages paid in each case and the period of their employment during the calendar year 1913. Presented April 30, 1914.—*Mr. Lemieux*.....*Not printed.*

232*r*. Return to an Order of the House of the 16th March, 1914, for a copy of all letters, telegrams, correspondence, reports, petitions, and communications filed in the Department of Public Works since 1910, relating to the dredging of Antigonish harbour, or the straightening or widening of the channel, or other improvements proposed to be made there. Presented April 30, 1914.—*Mr. Chisholm (Antigonish)*.....*Not printed.*

232*s*. Return to an Order of the House of the 23rd March, 1914, for a copy of all letters, papers and other documents relative to the purchase of a lot of land in the town of Stellarton, for a public building. Presented April 30, 1914.—*Mr. Macdonald*.....*Not printed.*

232*t*. Return to an Order of the House of the 2nd February, 1914, for a copy of all papers, correspondence, telegrams, letters, pay-rolls, accounts, and vouchers in any way referring to the expenditure of money by this Government in the construction of the new telegraph or telephone line from Baddeck, Victoria County, N.S. ,to North East Margaree, Inverness County, N.S., thence to Big Intervale, Inverness County, N.S., and also in connection with the lines from South West Margaree to Loch Ban, and from Scotsville to Whycocomagh, all in Inverness County, N.S. Presented May 4, 1914.—*Mr. Chisholm (Antigonish)*.....*Not printed.*

232*u*. Return to an Order of the House of the 2nd February, 1914, for a copy of all papers, documents, telegrams, correspondence, &c., in reference to the purchase of a property or site on Gottingen street, Halifax, for the erection of a post office building. Presented May 4, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

232*v*. Return to an Order of the House of the 16th March, 1914, for a return showing all payments made in the year 1913 in connection with repairs done to, or moneys expended on, the Blue Rock breakwater in Antigonish County, with the names of the persons to whom such payments were made, the amount paid to each, and what such amounts were for. Presented May 4, 1914.—*Mr. Chisholm (Antigonish)*.....*Not printed.*

232*w*. Return to an Order of the House of the 9th March, 1914, for a copy of all papers, documents, correspondence, &c., from any person or persons in connection with the purchase of the site for the post office at Canning, N.S. Presented May 4, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

232*x*. Return to an Order of the House of the 2nd February, 1914, for a copy of all tenders received for the construction of a lighthouse at Grand Anse, Gloucester County, N.B., and of the contract awarded. Presented May 5, 1914.—*Mr. Turgeon*.....*Not printed.*

232*y*. Return to an Order of the House of the 16th February, 1914, for a copy of all papers, letters, telegrams, reports, deeds, fees paid to lawyers, and other documents relative to the purchasing of land from Mrs. C. F. Bertrand and Arthemise Dionne, in connection with the works on the southwest side of Rivière-Verte, l'Islet, County of Témiscouata. Presented May 5, 1914.—*Mr. Gauvreau* .....*Not printed.*

232*z*. Return to an Order of the House of the 20th April, 1914, for a copy of all correspondence between the Minister of Public Works, the Minister of Justice, or any other member of the Government, and any person or persons, relating to the location and erection of the new post office in the village of Eganville, County of Renfrew. Presented May 5, 1914.—*Mr. Graham* .....*Not printed.*

232 (2*a*). Return to an Order of the House of the 16th March, 1914, for a copy of all correspondence, documents, recommendations and reports, respecting the dredging of Des Prairies river, the work done, depth, length and width of channel dredged, the list of men employed to perform that work, their salaries respectively, and the amount of money spent on that work since the 22nd of November, 1912, up to the 2nd of February, 1914. Presented May 7, 1914.—*Mr. Wilson (Laval)* .....*Not printed.*

232 (2*b*). Return to an Order of the House of the 6th April, 1914, for a copy of all letters, telegrams, correspondence, complaints, bills, accounts, vouchers, receipts and any documents in any way connected with the expenditure of money at Friar's Head Boat Harbour by Simon P. Doucet, during the years 1912-13, 1913-14. Presented May 7, 1914.—*Mr. Chisholm (Inverness)* .....*Not printed.*

232 (2*c*). Return to an Order of the House of the 16th February, 1914, for a copy of all papers in connection with the public building at Gravelburg, from and since January 1, 1912. Presented May 7, 1914.—*Mr. Knowles* .....*Not printed.*

232 (2*d*). Return to an Order of the House of the 23rd March, 1914, for a copy of all specifications and of all tenders pertaining to the Brantford public building now being erected, and of the contract awarded, and of all correspondence, whether by letter or telegram, with reference thereto. Presented May 7, 1914.—*Mr. Nesbitt*.....*Not printed.*

232 (2*e*). Return to an Address to His Royal Highness the Governor General of the 9th February, 1914, for a copy of all correspondence, telegrams, petitions and memorials received by the Right Honourable R. L. Borden, Premier of Canada, or any other Minister of the Crown since the first day of October, 1911, from J. A. Gillies, Esq., N.S., or any resident of the County of Richmond, N.S., relative to expenditure of public money on public works in the said County of Richmond. Presented May 8, 1914.—*Mr. Kyte.* *Not printed.*

232 (2*f*). Supplementary Return to an Order of the House of the 20th April, 1914, for a copy of all correspondence betewen the Minister of Public Works, the Minister of Justice or any other member of the Government, and any person or persons, relating to the location and erection of the new post office in the village of Eganville, County of Renfrew. Presented May 8, 1914.—*Mr. Graham* .....*Not printed.*

232 (2*g*). Return to an Order of the House of the 2nd February, 1914, for a return showing the dredging operations carried on in Bonaventure County in 1913, together with a copy of estimates, reports, and correspondence. Presented May 11, 1914.—*Mr. Marcil.* *Not printed.*

232 (2*h*). Return to an Order of the House of the 9th February, 1914, for a copy of all correspondence and other documents in reference to the erection of a customs building in the village of Chesley, Riding of South Bruce. Presented May 12, 1914.—*Mr. Truax.* *Not printed.*

232 (2*i*). Return to an Order of the House of the 6th April, 1914, for a copy of all accounts and vouchers covering the expenditure during the calendar year 1913 at South Lake, Lakevale, Antigonish County, and showing in detail, the persons to whom such payments were made, what such payments were for, the number of day labourers employed, and the rate of wages, the quantity of material used and the price paid therefor, the quantity of material hauled to the work and not used, and the persons supplying such material. Presented May 12, 1914.—*Mr. Chisholm (Antigonish).* *Not printed.*

232 (2*j*). Return to an Order of the House of the 23rd February, 1914, for a copy of all letters, papers, telegrams, valuations, appraisals and other documents relative to the obtaining of a site for a public building at Hantsport, Nova Scotia. Presented May 12, 1914.—*Mr. Macdonald* .....*Not printed.*

232 (2*k*). Return to an Order of the House of the 11th February, 1914, for a copy of all correspondence, letters, telegrams, reports, appraisals and other documents relative to the expropriation of the lands of John Campbell and Albert E. Milligan, in connection with the improvements on the East River at Pictou. Presented May 12, 1914.—*Mr. Macdonald* .....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

232 (2*l*). Return to an Order of the House of the 16th March, 1914, for a copy of all papers, letters and other documents, including pay-lists relating to the expenditure of moneys by the Public Works Department on Falmouth Township Dyke, Hants County, in 1913. Presented May 12, 1914.—*Mr. Macdonald*.....*Not printed.*

232 (2*m*). Return to an Order of the House of the 16th March, 1914, for a copy of all accounts, vouchers, pay-rolls, instructions, correspondence and recommendations relating to the expenditure on the public building at Arichat, N.S., since the 11th day of October, 1911. Presented May 16, 1914.—*Mr. Kyte* .....*Not printed.*

232 (2*n*). Return to an Order of the House of the 4th March, 1914, for a copy of all correspondence and other documents in connection with the letting of the construction for the Toronto harbour works. Presented May 16, 1914.—*Mr. Pardee*.....*Not printed.*

232 (2*o*). Return to an Order of the House of the 2nd February, 1914, for a return showing the nature and cost of works carried on in the County of Bonaventure by the Department of Public Works since October 10, 1911, to date, together with a copy of all reports, estimates, pay-lists, and correspondence in connection therewith. Presented May 27, 1914.—*Mr. Marcil (Bonaventure)* .....*Not printed.*

232 (2*p*). Return to an Order of the House of the 23rd March, 1914, for a copy of all correspondence, documents, recommendations and reports respecting the dredging at Port Elgin, Westmorland County, N.B., with the names of men employed to perform that work, their salaries, respectively, and the amount of money spent on the same from January 1, 1901, to January 1, 1914. Presented May 27, 1914.—*Mr. Robidoux.* *Not printed.*

232 (2*q*). Further Supplementary Return to an Order of the House of the 20th April, 1914, for a copy of all correspondence between the Minister of Public Works, the Minister of Justice, or any other member of the Government, and any person or persons, relating to the location and erection of the new post office in the village of Eganville, County of Renfrew. Presented May 27, 1914.—*Mr. Graham*.....*Not printed.*

232 (2*r*). Return to an Order of the House of the 16th February, 1914, for a copy of all papers in connection with the Immigration Hall at Gravelburg, Sask., from and since the 1st January, 1912. Presented June 1, 1914.—*Mr. Knowles*.....*Not printed.*

232 (2*s*). Return to an Order of the House of the 2nd February, 1914, for a copy of all advertisements, tenders, accounts, vouchers, letters, documents and correspondence relating to the construction of a breakwater at The Graff, Halifax County, N.S. Presented June 2, 1914.—*Mr. Maclean (Halifax)* .....*Not printed.*

232 (2*t*). Return to an Order of the House of the 23rd February, 1914, for a copy of all letters, telegrams, correspondence, contracts and documents relating to the surrender of a contract for dredging in Miramichi Bay, N.B., by Messrs. A. and R. Loggie, and also with reference to the letting of a contract for the same, or any portion of said work, to the Northern Dredging Company; together with a copy of all notices for tenders, tenders and contracts in connection therewith. Presented June 2, 1914.—*Mr. Carvell.* *Not printed.*

232 (2*u*). Return to an Order of the House of the 6th April, 1914, for a copy of all letters, telegrams, documents, papers, &c., in connection with the purchase by the Government of lots 1 and 2, block 125, plan 96, in the city of Moosejaw, for an examining warehouse site. Presented June 2, 1914.—*Mr. Knowles*.....*Not printed.*

232 (2*v*). Return to an Order of the House of the 16th February, 1914, for a copy of all letters, telegrams, correspondence of all kinds, pay-rolls, vouchers, &c., in any way referring to the expenditure of moneys on sheer dams on the Margaree river, at Margaree and North East Margaree, during 1911-1912 and 1912-1913. Presented June 2, 1914.—*Mr. Chisholm (Inverness)* .....*Not printed.*

233. Return to an Order of the House of the 24th April, 1913, for a return showing what officers and men were employed on the dredge *Northumberland* at Pictou in the months of January, February and March, 1913, and the salaries and wages paid to them respectively; the amounts paid for repairs and supplies respectively, for said dredge during said months and to whom paid respectively. Presented April 2, 1914.—*Mr. Macdonald.* *Not printed.*

234. New Lobster Fishery Regulations established by Order in Council of the 25th March, 1914, in lieu of those established by Order in Council of the 30th September, 1910, and all amendments thereto, by virtue of the provisions of Section 54 of the Fisheries Act, chapter 45 of the Revised Statutes of Canada, 1906. Presented by Hon. Mr. Hazen, April 7, 1914 .....*Not printed.*

235. Return to an Order of the House of the 23rd March, 1914, for a return showing:—

1. How many engineers there are in the employ of the Intercolonial Railway at Moncton and at other points on that railway, and their names?

2. How many were formerly in the employ of the Canadian Pacific Railway Company?

3. Whether Martin Murphy, C.E., is employed in the service of that railway. If so, when he was employed and what his age is? Presented April 7, 1914.—*Mr. Emmerson* .....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

236. Return to an Order of the House of the 30th March, 1914, for a return showing the travelling expenses paid by the Government to the Honourable Rodolphe Roy, Judge of the Superior Court at Rimouski, during the years 1912-1913 and 1914, for trips from Quebec to Rimouski and return. Presented April 8, 1914.—*Mr. Boulay*.....*Not printed.*

237. Return to an Order of the House of the 23rd March, 1914, for a return showing:—
1. The names of the lawyers who represented the Department of Justice in the district of Quebec, since the 21st September, 1911.
2. The amount of money paid to each of them. Presented April 8, 1914.—*Mr. Lapointe (Kamouraska)* .....*Not printed.*

238. Return to an Order of the House of the 4th February, 1914, for a copy of all letters, telegrams and documents generally concerning the withdrawal of an appeal in the Supreme Court of Canada, in the case of His Majesty the King, appellant, and Alfred Olivier Falardeau and Constant Napoleon Falardeau, respondents. Presented April 8, 1914.—*Mr. Lemieux* .....*Not printed.*

239. Return to an Order of the House of the 16th March, 1914, for a copy of all transfers of lands by the Militia Department to the Harbour Commissioners of Montreal, and of all correspondence with regard to the same. Presented April 15, 1914.—*Mr. Carvell.*
Not printed.

240. Return to an Order of the House of the 2nd March, 1914, for a return showing:—
1. The quantities of wheat, by grade, received into the terminal elevators at Fort William and Port Arthur, from the date of the weigh-up in 1910, to date of weigh-up in 1911, the same for 1911-1912, and the same for 1912-1913.
2. The quantities, by grade, delivered by each of the said elevators during the same periods.
3. The average or shortage, as the case may be, of each grade in each of the said elevators, as shown by the said weigh-ups in each of those above mentioned periods.
4. The date of the weigh-up in each case. Presented April 15, 1914.—*Mr. Neely.*
Not printed.

241. Return to an Order of the House of the 2nd March, 1914, for a copy of all rules, orders and regulations, &c., affecting the handling of grain made by the Grain Commission to date, and of any changes made in elevator charges and terms, if any. Presented April 15, 1914.—*Mr. Neely* .....*Not printed.*

242. Return to an Order of the House of the 6th April, 1914, for a copy of the new rules and regulations in regard to employees of the Intercolonial Railway and Prince Edward Island Railways. Presented April 15, 1914.—*Mr. Macdonald*.....*Not printed.*

243. Return to an Address to His Royal Highness the Governor General of the 30th March, 1914, for a copy of all correspondence, petitions, lists of shareholders, Orders in Council, licenses, certificates and other papers and documents, and of all renewals thereof, relating to the incorporation and licensing of the Banque St. Jean, the Banque Ville Marie and the Banque Jacques Cartier, all in the Province of Quebec. Presented April 16, 1914.—*Mr. Demers* .....*Not printed.*

243*a*. Return to an Address to His Royal Highness the Governor General of the 23rd March, 1914, for a copy of all correspondence, petitions, lists of shareholdres, Orders in Council, licenses, certificates and other papers and documents and all renewals thereof, relating to the incorporation and licensing of the Bank of Yarmouth, and of all papers and documents relating to the winding up of the business of the said bank. Presented April 16, 1914.—*Mr. Law*.....*Not printed.*

243*b*. Return to an Address to His Royal Highness the Governor General, of the 16th March, 1914, for a copy of all correspondence, petitions, lists of shareholdres, Orders in Council, licenses, certificates and other papers and documents and all renewals thereof, relating to the incorporation and licensing of the Pictou Bank, and of all papers and documents relating to the winding up of the business of the said bank. Presented April 30, 1914. —*Mr. Macdonald* .....*Not printed.*

244. Return to an Order of the House of the 23rd March, 1914, for a cpoy of the reports made by Colin F. McKinnon, of Taylor's Road, Antigonish County, Frank A. McEchen, of Inverness, N.S., John A. McDougall of Glace Bay, C.B., J. M. McDonald, of Christmas Island, C.B., William Watkins of Cobourg Road, Halifax, S. P. Fream, of Brighton, Digby County, and J. J. Walker of Truro, N.S., special immigration agents appointed from the Province of Nova Scotia. Presented April 16, 1914.—*Mr. Chisholm (Antigonish)* .....*Not printed.*

245. Return to an Address to His Royal Highness the Governor General of the 4th February, 1914, for a copy of all correspondence and papers generally concerning the proposed changes of the Judicial Committee of the Privy Council. Presented April 16, 1914.—*Mr. Lemieux* .....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

246. Return to an Order of the House of the 2nd March, 1914, for a return giving the following information, as far as may be available, respecting the constitution of Upper Chambers or Senates within the British Empire and in foreign countries, and especially such information in respect of the self-governing Dominions and of foreign countries possessing a federal system of Government:—

1. As to the method of appointment, whether by executive authority or by election by the people, or otherwise.
2. As to the term of appointment, whether for life or for a term of years, or toherwise.
3. As to a re-appointment or re-election, and generally as to the filling of vacancies occasioned by death or otherwise.
4. As to qualifications, whether by age, residence, possession of real or personal property or otherwise.
5. As to limitation of the membership, and as to the numerical relation of the membership to that of the Lower House.
6. As to provisions for dissolution, appeal to the electorate, conferences or additional appointments in case of disagreement between the Upper and Lower House.
7. As to the operation of the various systems in the several Dominions and countries mentioned, and in what respect defects or difficulties have made themselves manifest.
8. All other relevant information respecting the constitution and status of such Upper Chambers. Presented April 16, 1914.—*Mr. Middlebro.*

Printed for sessional papers only.

246a. Further Supplementary Return to an Order of the House of the 2nd March, 1914, for a return giving the following information, as far as may be available, respecting the constitution of Upper Chambers or Senates within the British Empire and in foreign countries, and especially such information in respect of the self-governing Dominions and of foreign countries possessing a federal system of Government:—

1. As to the method of appointment, whether by executive authority or by election by the people, or otherwise.
2. As to the term of appointment, whether for life or for a term of years, or otherwise.
3. As to a re-appointment or re-election, and generally as to the filling of vacancies occasioned by death or otherwise.
4. As to qualifications, whether by age, residence, possession of real or personal property or otherwise.
5. As to limitation of the membership, and as to the numerical relation of the membership to that of the Lower House.
6. As to provisions for dissolution, appeal to the electorate, conferences or additional appointments in case of disagreement between the Upper and Lower Houses.
7. As to the operation of the various systems in the several Dominions and countries mentioned, and in what respect defects or difficulties have made themselves manifest.
8. All other relevant information respecting the constitution and status of such Upper Chambers. Presented June 10, 1914.—*Mr. Middlebro....*

Printed for sessional papers only.

247. Return to an Order of the House of the 1st April, 1914, for a return showing:—

1. What it has cost the Government for bottled and distilled water in Ottawa since January 1, 1912, to March 1, 1914?
2. What it is costing the Government per day now for bottled and distilled water? Presented April 16, 1914.—*Mr. Sexsmith*.....*Not printed.*

248. Return to an Order of the House of the 11th February, 1914, for a copy of all papers, letters, telegrams, reports and other documents relative to the purchase of land from Joseph Fraser, in connection with the works at Cariboo Island, Pictou County, in the Public Works Department. Presented April 16, 1914.—*Mr. Macdonald....Not printed.*

249. Return to an Order of the House of the 21st May, 1913, for a copy of all correspondence exchanged during the year 1912, between Captain Belanger, commandant of the *Eureka* and the Department of Marine and Fisheries, both at Quebec and Ottawa. Presented April 16, 1914.—*Mr. Boulay* .....*Not printed.*

250. Return to an Order of the House of the 23rd March, 1914, for a return showing:—

1. The names of the wharfingers at Coteau Landing from 1900 to 1914.
2. The names of the vessels which moored there during that period.
3. What wharfage each of those vessels paid during that time?
4. What wharfage a coaler paid for unloading between 1900 and 1912? Presented April 17, 1914.—*Mr. Paquet*.....*Not printed.*

251. Return to an Order of the House of the 4th March, 1914, for a copy of all correspondence, letters, telegrams and documents in connection with the removal of ice in Yarmouth, N.S., harbour, by C.G.S. *Stanley* in February, 1914. Presented April 21, 1914.—*Mr. Law* .....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

252. Report of the Royal Commission on Penitentiaries, together with the evidence taken and exhibits filed before the said commission. Presented by Hon. Mr. Doherty, April 22, 1914. (Report only) .....*Printed for distribution and sessional papers.*

253. Return to an Order of the House of the 9th March, 1914, for a return showing:—

1. How many professors, lecturers and inspectors the Department of Agriculture has in the Province of Prince Edward Island?

2. Their names, the salaries they receive, and the travelling expenses of each.

3. The duties of these professors, lecturers and inspectors?

4. How many meetings were held or demonstrations given by each of these professors, lecturers and inspectors during the months of March, April, May, June, July, August, September and October last year?

5. Where each meeting was held or demonstration given, and how each was advertised?

6. How many boxes, baskets and barrels of fruit were inspected last season, and the kinds of fruit so inspected?

7. When and where the inspection took place and how many boxes, baskets and barrels were found to be improperly or falsely marked?

8. Whether the Department received a resolution or petition from the Fruit Growers' Association of Prince Edward Island.

9. If so, what prayer or request the said resolution or petition contained, and what the Department has decided to do in regard to the matter?

10. How many cheese and butter factories were operated in each of the counties of Prince Edward Island in the year 1910 and how many in the year 1913. Presented April 22, 1914.—*Mr. Hughes (P.E.I.)*.....*Not printed.*

254. Return to an Order of the House of the 26th February, for a return showing:—The freight rates charged during the years 1912 and 1913 on wheat from Fort William or Port Arthur to ports on the Georgian Bay and Canadian ports on Lake Huron and Lake Erie, by the Canadian Pacific Steamship Line, the Northern Navigation Company, the Merchant's Mutual Line, Inland Lines, and the Canadian Lake Line. Presented April 24, 1914.—*Mr. Aikins* .....*Not printed.*

255. Return to an Order of the House of the 23rd March, 1914, for a copy of all letters, papers, telegrams, recommendations and documents of every kind in connection with the purchase of a Rifle Range near Souris, Prince Edward Island. Presented April 27, 1914. —*Mr. Hughes (P.E.I.)*.....*Not printed.*

256. Return to an Order of the House of the 2nd February, 1914, for a copy of all papers, advertisements, tenders, bids, contracts, telegrams, correspondence, accounts, receipts, vouchers, &c., in reference to the supply of meats, hay, oats, and all other supplies for the 1913 summer and autumn drill at Aldershot Camp, Nova Scotia. Presented April 27, 1914.—*Mr. Maclean (Halifax)*.....*Not printed.*

256*a*. Return to an Order of the House of the 30th March, 1914, for a copy of all advertisements, tenders, contracts, documents, papers, &c., relative to the supply of ice for the Aldershot Military Camp, N.S., for the season of 1914. Presented May 29, 1914.—*Mr. Maclean (Halifax)* .....*Not printed.*

257. Return to an Order of the House of the 1st April, 1914, for a Return showing:—

1. The total amount paid for pensions by the Department of Militia and Defence for the year ending March 31, 1913.

2. The number of militia officers at present on the pay-roll of the permanent corps.

3. How many private soldiers are at present on the pay-roll of the permanent force?

4. How many private soldiers joined the force during 1913?

5. How many deserted during 1913?

6. The gross amount expended by the Department of Militia and Defence for the salaries of officers and officials of every kind in the employ of the Department at Ottawa or elsewhere during the fiscal year 1912-1913.

7. The gross amount paid out for services to the private soldiers of the permanent corps during the said year 1912-1913. Presented April 27, 1914.—*Mr. Sinclair.*

Not printed.

258. Return to an Order of the House of the 4th February, 1914, for a copy of all letters, telegrams, &c., exchanged between the Department of Militia and Messrs. A. Macdonald, E. Montpetit and others, in connection with the organization of the 33rd Hussars, at Vaudreuil and Soulanges. Presented April 27, 1914.—*Mr. Boyer*.....*Not printed.*

259. Return to an Order of the House of the 9th March, 1914, for a copy of all letters, telegrams, reports, and other correspondence, in possession of the Department of Militia and Defence, relating to the purchase of land in Farnham, Quebec, for a military camp ground. Presented April 27, 1914.—*Mr. Kay*..... *Not printed.*

260. Return to an Order of the House of the 2nd February, 1914, for a copy of all correspondence between the Department of Agriculture or the Department of Customs and C. S. Campbell, Esq., K.C., relating to the importation of pure-bred animals into Canada. Presented April 27, 1914.—*Mr. Kay* .....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

261. Return to an Order of the House of the 2nd March, 1914, for a copy of all correspondence, letters, telegrams, and other documents relative to the immigration of Asiatics, including Hindus, Japanese and Chinese, which have a bearing either directly or indirectly upon the Order in Council passed by the Government during December, 1913, restricting immigration into the Province of British Columbia. Presented April 27, 1914.—*Mr. Oliver* ..... *Not printed.*

262. Return to an Address to His Royal Highness the Governor General of the 30th March, 1914, for a copy in duplicate of all leases, agreements, correspondence, Orders in Council and other documents relating to the water-power or privileges connected with the Stevens Dam, so called, that had been constructed across the River Trent at the village of Campbellford, together with a copy in duplicate of a license in connection with said dam, granted to the Honourable James Cockburn and others under date December 9, 1869, and of all correspondence with, and opinions of, the Minister of Justice at the time of the granting of said license and since that date; also a duplicate copy of all papers, correspondence, Orders in Council and other documents relating to or connected with the cancellation, termination and revocation of such license on the 12th of August, 1911, and of all correspondence, propositions, agreements or other documents had and made by, to or with the Trent Valley Woollen Manufacturing Company, Limited, and of all correspondence with the Department of Justice and opinions thereof relating thereto; also a duplicate copy of all correspondence, reports, Orders in Council and other documents referred to or mentioned in an Order in Council of date August 25, 1913, set forth on page W 398, in the third volume of the Auditor General's Report, 1913, and of all correspondence with the Auditor General and by and between the Auditor General and any department of Government relating thereto or connected therewith. Presented April 27, 1914.—*Mr. Emmerson* ..... *Not printed.*

263. Return to an Order of the House of the 2nd February, 1914, for a copy of all papers, deeds, contracts, &c., in connection with the purchase by the Board of Harbour Commissioners of Quebec, of a stone quarry at St. Nicholas, Que. Presented April 28, 1914.—*Mr. Lemieux* ..... *Not printed.*

264. Return to an Order of the House of the 6th April, 1914, for a copy of all petitions, correspondence, telegrams and other papers and documents received by the Department of Marine and Fisheries since January 1, 1914, relating to the transportation of fish from the Maritime Provinces to the United States, and of all replies thereto. Presented April 29, 1914.—*Mr. Sinclair* ..... *Not printed.*

265. Return to an Order of the House of the 2nd February, 1914, for a copy of all papers, deeds and contracts in connection with the purchase by the Department of Agriculture of a quarantine station at Lévis, Que., on or about July 29, 1913. Presented April 29, 1914.—*Mr. Lemieux* ..... *Not printed.*

266. Copy of Order in Council No. P. C. 976, dated 18th April, 1914, "Revised Regulations governing the entry of Naval Cadets." Presented by Hon. Mr. Hazen, April 30, 1914. *Not printed.*

266a. Copy of Order in Council dated 18th May, 1914, concerning the organization of a Naval Volunteer Force. Presented by Hon. Mr. Hazen, May 23, 1914..... *Not printed.*

267. Return to an Order of the House of the 4th March, 1914, for a copy of all papers, correspondence and telegrams concerning the deportation of Bhwagan Singh, a Sikh priest, in defiance of a writ of Habeas Corpus. Presented April 30, 1914.—*Mr. Lemieux.* *Not printed.*

268. Statement of receipts and expenditures of the National Battlefields Commission to 31st March, 1914, as required by 7-8 Edward VII, chapter 57, section 12. Presented by Hon. Mr. White, May 4, 1914..... *Not printed.*

269. Copy of the trust deed, dated 30th June, 1903, between the Canadian Northern Railway Company and the British Empire Trust Company and the National Trust Company, Limited. Presented by Hon. Mr. Borden, May 4, 1914..... *Not printed.*

269a. Copy of the trust deed, dated 6th May, 1910, between the Canadian Northern Railway Company and the British Empire Trust Company and the National Trust Company, Limited. Presented by Hon. Mr. Borden, May 4, 1914..... *Not printed.*

269b. Copy of the trust deed, dated 19th November, 1913, between the Canadian Northern Railway Company, Mackenzie, Mann & Co., Limited, and the British Empire Trust Company, and the National Trust Company, Limited. Presented by Hon. Mr. Borden, May 4, 1914..... *Printed for distribution and sessional papers.*

269c. Statement showing the floating liabilities of the railway companies embraced in the general title of the Canadian Northern Railway System. Presented by Hon. Mr. Borden, May 4, 1914 ..... *Not printed.*

269d. Statement of securities pledged as collateral to temporary loans of the Canadian Northern System. Presented by Hon. Mr. Borden, May 4, 1914..... *Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

269*e*. Statement showing the engineer's estimate of the cost of completing the Canadian Northern Railway System. Presented by Hon. Mr. Borden, May 4, 1914.....*Not printed.*

269*f*. Statement of capital stock authorized and issued, of the companies set out in the first schedule. Presented by Hon. Mr. Borden, May 6, 1914.....*Not printed.*

269*g*. Approximate estimate of betterments for six years of the lines of the Canadian Northern Railway System. Presented by Hon. Mr. Borden, May 6, 1914.....*Not printed.*

269*h*. Statements as on 31st December, 1913, bearing on the financing of the Canadian Northern Railway System. Presented by Hon. Mr. Borden, May 6, 1914.....*Not printed.*

269*i*. Papers and statements in respect to the Canadian Northern Railway System:—
1. Correspondence, including official application for aid.
2. Detailed statements showing particulars of capitalization, earnings, cost to complete, &c. Presented by Hon. Mr. Borden, May 6, 1914.
Printed for distribution and sessional papers.

269*j*. Copy of trust deed dated October 4, 1911.—The Canadian Northern Railway to the Guardian Trust Company, Limited, and the British Empire Trust Company, Limited, and His Majesty the King and the Canadian Northern Railway Company. Presented by Hon. Mr. Borden, May 7, 1914.....*Printed for distribution and sessional papers.*

269*k*. List of companies whose total issued stock is owned by the Canadian Northern Railway Company; also, list of companies whose total issued stock is to be transferred to The Canadian Northern Railway Company; and also, list of companies in which the controlling interest is to be transferred to The Canadian Northern Railway Company. Presented by Hon. Mr. Borden, May 7, 1914.....*Not printed.*

269*l*. Further statements bearing on the financing of the Canadian Northern Railway System. Presented by Hon. Mr. Borden, May 7, 1914.
Printed for distribution and sessional papers.

269*m*. Correspondence and telegrams received from the premiers of the Provinces of Nova Scotia, British Columbia, Alberta, and the Acting Premier of Saskatchewan, in regard to the granting of aid to the Canadian Northern Railway System. Presented by Hon. Mr. Borden, May 7, 1914..... *Printed for distribution and sessional papers.*

269*n*. Copy of trust deed dated 28th December, 1903.—The Lake Superior Terminals Company Limited, and the National Trust Company, Limited, and the Canadian Northern Railway Company. Presented by Hon. Mr. Borden, May 11, 1914.....*Not printed.*

270. Return to an Order of the House of the 20th April, 1914, for a copy of all letters, telegrams and other documents relating to the refusal of the Railway Department, or any official of the Intercolonial Railway to permit employees of the railway at Moncton to attend the militia camp in the last year. Presented May 6, 1914.—*Mr. Macdonald.*
Not printed.

271. Return to an Order of the House of the 23rd March, 1914, for a copy of all correspondence received by the Government since October 1, 1911, to date, from John M. Cormick, of Sydney Mines, N.S., in reference to the following matters in the Riding of North Cape Breton and Victoria:—Railway extension into the Riding of North Cape Breton and Victoria; the opening of the harbour at Dingwall, Aspey Bay, C.B.; the breakwater at Meat Cove in the said Riding; the boat harbour at Bay St. Lawrence; the breakwater at White Point; the breakwater at Neil's Harbour; the breakwater at McLeod's, Ingonish; in respect to Ingonish Harbour; the breakwater at Breton Cove; the breakwater at Little Bras d'Or; the breakwater at Cape Dauphin; the breakwater at Point Aconi; the proposed wharf at North Sydney the proposed extension of the breakwater at North Sydney; the bringing of the Intercolonial Railway to the ballast ground at North Sydney; the wharf at Sydney Mines; the wharf at Leitches Creek; the repairs to the wharf at Groves Point; the rebuilding of the wharf at Boisdale; the breakwater at Jamesville; the wharf at Castle Bay, and the proposed wharf at Shenacadie. Presented May 7, 1914.—*Mr. McKenzie*.....*Not printed.*

272. Copy of all letters, documents and correspondence relating to action by the Government in regard to the relief of the shareholders and depositors of the Farmers Bank, and of the Order in Council appointing Sir William Meredith as Commissioner, and all correspondence in relation thereto. And also, Statement of Affairs, &c., relating to the Farmers Bank of Canada. Presented by Hon. Mr. White, May 8, 1914....*Not printed.*

273. Return to an Order of the House of the 6th April, 1914, for a copy of all letters, telegrams and correspondence received by the Postmaster General in connection with complaints made that the postmaster at Yarmouth North, N.S., had been or is selling stamps outside his jurisdiction. Presented May 8, 1914.—*Mr. Law*.....*Not printed.*

274. Return to an Order of the House of the 9th February, 1914, for a return showing the number of criminals released on parole from the various penitentiaries of the Dominion for the year ending March 31, 1913; the offence for which each prisoner so released was convicted, and showing at the same time whether such offence was a first, second, or subsequent offence. Presented May 8, 1914.—*Mr. Sinclair*.....*Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

275. Return to an Order of the House of the 9th March, 1914, for a return showing:—
1. How many acres of public land have been given to railway companies in the Dominion of Canada by the Federal Government from 1878, to the present time?
2. How many acres were granted in each year during the above period of time Presented May 11, 1914.—*Mr. Tobin* ..... *Not printed.*

276. Return to an Order of the House of the 2nd February, 1914, for a return showing the receipts and expenses of the post office at St. Philippe, East, and of the post office at St. Philippe, West, in the parish of St. Philippe de Néri, since the first of June, 1912, to date. Presented May 11, 1914.—*Mr. Lapointe (Kamouraska)* ..... *Not printed.*

277. Report of the Dominion Wreck Commissioner in the matter of a formal investigation into the causes which led to the British steamer *Saturnia* touching the ground in the Lower Traverse, River St. Lawrence, on Tuesday, April 28, 1914. Presented by Hon. Mr. Hazen, May 12, 1914..... *Printed for sessional papers only*

278. Report of the Dominion Wreck Commissioner in the matter of a formal investiagtion into the causes which led to the stranding of the British steamship *Montfort*, on Beauport Bank, River St. Lawrence, on Tuesday, April 28, 1914. Presented by Hon. Mr. Hazen, May 12, 1914..... *Printed for sessional papers only.*

279. Return to an Address to His Royal Highness the Governor General of the 2nd February, 1914, for a copy of the Order in Council appointing Arthur Plaunte, Esq., a Commissioner to receive claims against the Atlantic and Lake Superior Railway, the Baie des Chaleurs Railway and the Quebec Oriental Railway, and of the report of said Commissioner and of the statement of claims accepted and those rejected by him, with the reasons therefor, as well as of all correspondence, memorials, petitions and documents, generally bearing on said subject. Presented May 12, 1914.—*Mr. Marcil (Bonaventure)* ..... *Not printed.*

279a. Supplementary Return to an Address to His Royal Highness the Governor General of the 2nd February, 1914, for a copy of the Order in Council appointing Arthur Plaunte, Esq., a Commissioner to receive claims against the Atlantic and Lake Superior Railway, the Baie des Chaleurs Railway and the Quebec Oriental Railway and of the report of said Commissioner and of the statement of claims accepted and those rejected by him, with the reasons therefor, as well as of all correspondence, memorials, petitions and documents, generally bearing on said subject. Presented May 22, 1914.—*Mr. Marcil (Bonaventure)* ..... *Not printed.*

280 Return to an Order of the House of the 6th April, 1914, for a copy of all correspondence, accounts, indemnities, travelling expenses, &c., from Fraserville to Quebec, and of all other documents relating to the amount of money received each year by His Honour Mr. Justice Ernest Cimon, from 1890 to 1913, as Judge of the Superior Court sitting at Quebec, during the time he was connected with the District of Kamouraska. Presented May 16, 1914.—*Mr. Gauvreau* ..... *Not printed.*

281. Report of the delegates appointed by the Government of Canada to attend the "International Purity Congress," held in the city of Minneapolis, Minn., November 7-12, 1913. Presented by Hon. Mr. Borden, May 16, 1914..... *Not printed.*

282. Agreement between the Government and steamship companies for mail carriage between Canadian and European ports.—(*Senate*)..... *Not printed.*

283. Return to an Order of the House of the 15th April, 1914, for a return showing:—
1. How many passengers have been carried over the Intercolonial Railway from St. John to Halifax, and from Halifax to St. John, respectively, under the agreement made on the 30th September, 1913, between the Canadian Government Railways by F. P. Gutelius, General Manager and the Canadian Pacific Railway Comapny, by G. M. Bosworth, General Traffic Manager, from the 15th November, 1913, when the said agreement went into effect, to the 31st March last?
2. How many tons of freight of each of the classes mentioned in said agreement have been carried each way over the Intercolonial Railway between St. John and Halifax, under said agreement during said period?
3. What have been the total earnings by the Intercolonial Railway under said agreement up to the 31st March last, for passengers and freight carried, respectively?
4. What amount has been paid to or earned by the Canadian Pacific Railway for car hire under said agreement?
5. What number of empty cars of the Canadian Pacific Railway Company have been hauled by the Intercolonial Railway free under said agreement, and what has been the cost of such haulage?
6. What would have been the total amount paid by the Canadian Pacific Railway Company to the Intercolonial Railway, under the tariff prevailing at the time of the making of said agreement, for the passengers and the freight so carried, respectively?
7. Whether the said agreement has been submitted, as promised by the Government, to the Board of Railway Commissioners by the Minister of Railways for the purpose of having the Board determine as to whether or not said agreement is discriminatory against the port of St. John. If not, why was it not so submitted?

CONTENTS OF VOLUME 28—*Continued.*

8. If it is the intention of the Minister of Railways to renew the said agreement, or to put in force a similar agreement, during the next Winter Port season.

9. What agreement the Government intends to make as to the Atlantic termini of the fast Atlantic mail steamers for the winter of 1914-1915. Presented May 22, 1914.—*Mr. Pugsley* ..... *Not printed.*

284. Return to an Order of the Senate dated 15th May, 1914:—

1. How many judges have been retired since 1880?
2. What are their names?
3. What salary did they receive in each case?
4. How many years did they serve in each case?
5. What was the reason given for their retirement?
6. How much did they receive for retirement allowance each year in each case? Ordered, that the same do lie on the table, and it is as follows.—(*Senate*).

Not printed.

285. Return to an Address to His Royal Highness the Governor General of the 9th March, 1914, for a copy of all petitions, letters, telegrams and documents by any and all parties to and by the Department of Railways and Canals, or any other Department of the Government, with reference to the Southampton Railway Company, also of all reports of engineers and recommendations regarding a subsidy to the said railway, and of all Orders in Council granting same, and of all other documents and memoranda in the possession of the Department of Railways and Canals or other Departments of the Government regarding the said railway. Presented May 27, 1914.—*Mr. Carvell.*

Not printed.

286. Return to an Order of the House of the 2nd February, 1914, for a copy of all correspondence, papers, documents, contracts, &c., between the Government of Canada and any company, firm or individuals from May 1, 1913, to December 1, 1913, referring to the establishment of a subsidized steamship service between Canada and the British West Indies. Presented May 27, 1914.—*Mr. Maclean (Halifax)* ..... *Not printed.*

287. Return to an Order of the House of the 4th May, 1914, for a copy of all papers, letters, telegrams, accounts and receipts concerning advances made to the Montagnais Band of Indians through the agency of Seven Islands, Quebec. Presented May 29, 1914.—*Mr. Lemieux* ..... *Not printed.*

288. Return to an Order of the House of the 11th May, 1914, for a copy of all papers, letters, telegrams, accounts and receipts, concerning advances or payments made by the Government to Newton Wesley Rowell, K.C., for legal services in connection with the Oko Indian litigation. Presented May 29, 1914.—*Mr. Sharpe (Ontario)*..... *Not printed.*

288*a*. Return to an Order of the House of the 6th May, 1914, for a return showing:—

1. Whether the Government paid Newton Wesley Rowell, K.C., any sums of money for legal services during the past fifteen years?
2. If so, the amounts and when?
3. Whether the Government paid the firm of which Mr. Rowell is the senior partner any sums of money for legal services?
4. If so, the amounts and in what years? Presented May 29, 1914.—*Mr. Sharpe (Ontario)* ..... *Not printed.*

289. Return to an Order of the House of the 20th April, 1914, for a return showing:—

1. The date of the incorporation of the Canadian National Bureau of Breeding, Limited, with the names, addresses and occupations of the charter members of said Company.
2. The amount of capital of the Company and the number of shares into which it is divided.
3. The number of shares taken from the commencement of the Company up to the date of the return.
4. The amount of calls made on each share, the total amount of calls received, the total amount of calls unpaid, and the total number of shares forfeited.
5. The names, addresses and occupations of the persons who have ceased to be members within the twelve months next preceding, and the number of shares held by each of them.
6. The amount of money paid to said Company by the Government in each year since incorporation. Presented May 29, 1914.—*Mr. Sutherland*..... *Not printed.*

290. Return to an Order of the House of the 9th February, 1914, for a copy of all reports made by the inspectors of agents for placing farm labourers and domestic servants in Canada during the calendar years 1912 and 1913. Presented May 29, 1914.—*Mr. Sutherland.*

Not printed.

291. Return to an Order of the House of the 2nd March, 1914, for a return showing all the buildings, houses, offices and immoveables, occupied by the Federal Government in Montreal, for the use of the various Departments and services of each branch of the administration, together with the following information in each case; for what Department and for what service; where situated, street and number thereof; whether Government property or under lease; in the latter case, the length of lease, the rent per annum and also the other charges that may be imposed upon the Government. Presented June 4, 1914.—*Mr. Wilson (Laval)* ..... *Not printed.*

CONTENTS OF VOLUME 28—*Continued.*

292. Return to an Order of the House of the 4th May, 1914, for a copy of all correspondence exchanged by and with the Department of Public Works or the Post Office Department, relating to an application or applications for a post office building at the town of Melville, Province of Saskatchewan. Presented June 4, 1914.—*Mr. MacNutt.*
Not printed.

293. Memorandum, correspondence, estimates of cost, &c., in connection with the construction of the Grand Trunk Pacific Railway—Mountain Section. Presented by Hon. Mr. Borden, June 4, 1914.....*Not printed.*

294. Return to an Order of the House of the 4th February, 1914, for a return showing the names and addresses of the people with whom pure bred animals have been placed by the Department of Agriculture, the breed in each case, and the conditions on which these animals were placed. Presented June 5, 1914.—*Mr. Kay*.....*Not printed.*

295. Return to an Order of the House of the 30th March, 1914, for a copy of all correspondence, telegrams, instructions, accounts, vouchers and other papers and documents relating to the purchase of live stock in the Maritime Provinces by one Howard Corning of Yarmouth, N.S., during the period of his employment; also a copy of the appointment of the said Howard Corning and of all correspondence, complaints and other documents relating to the dismissal of the said Howard Corning, if he has been dismissed or retired from the service, together with a copy of all recommendations, correspondence and other papers relating to the appointment of the said Howard Corning's successor. Presented June 5, 1914.—*Mr. Sinclair* .....*Not printed.*

296. Return to an Order of the House of the 19th March, 1914, for a return showing:—
1. How many pure bred stallions and bulls have been purchased by the Department of Agriculture for the use of settlers in the Provinces of Manitoba, Saskatchewan and Alberta since the first of January, 1912, to date.?
2. Where these animals were purchased, and from whom; and also the price paid for them respectively. Presented June 5, 1914.—*Mr. Douglas*.....*Not printed.*

297. Return to an Order of the House of the 9th February, 1914, for a copy of all correspondence, including letters, telegrams and accounts, regarding the purchase and disposal during year 1913, of all horses, cattle, sheep and swine for the Department of Agriculture, Province of Quebec for Experimental Farms, or for the improvement of stock, together with a return showing the commission and fees paid, and to whom paid, for and on account of said purchases. Presented June 8, 1914.—*Mr. Robb*....*Not printed.*

298. Return to an Address to His Royal Highness the Governor General of the 9th February, 1914, for a copy of all arrangements made between the Government and the various Provinces under the Agricultural Instruction Act. Presented June 10, 1914.—*Sir Wilfrid Laurier* .....*Not printed.*

299. Partial Return to an Address to His Royal Highness the Governor General of the 4th March, 1914, for a copy of all correspondence, telegrams, petitions, Orders in Council, and other papers and documents, relating to subventions or assistance given, or to be given, by the Department of Marine and Fisheries or the Department of Agriculture to firms or joint stock companies, or persons operating cold storage plants for the preservation of fish products in Nova Scotia during the years 1908, 1909, 1910, 1911, 1912 and 1913, excluding such correspondence, &c., as relates to companies known as Fishermen's Bait Association. Presented June 10, 1914.—*Mr. Sinclair*.....*Not printed.*

300. Copy of Order in Council No. P.C. 1386, of the 29th May, 1914, concerning the regulations governing the Radiotelegraph administration. Presented by Hon. Mr. Hazen, June 11, 1914 .....*Not printed.*

300*a*. Copy of regulations governing Radiotelegraphy promulgated under section 11, Radiotelegraph Act, 1913. Presented by Hon. Mr. Hazen, June 11, 1914.....*Not printed.*

301. Return to an Order of the House of the 27th April, 1914, for a copy of all letters, tenders, telegrams, plans, specifications and other documents in regard to the construction of the new ice breaker by the Canadian Vickers Company of Montreal. Presented June 11, 1914.—*Mr. Macdonald* .....*Not printed.*

302. Return to an Address to His Royal Highness the Governor General of the 16th March, 1914, for a copy of all petitions, letters, affidavits, telegrams and documents to and by the Department of Justice, or any oaher Department of Government, on behalf of or in reference to Wm. J. Kelley, a prisoner in the United States federal prison at Atlanta, Ga., and of all the letters, telegrams and other memoranda between the Department of Justice, or any other Department of the Government, and the British Ambassador at Washington, or the Government of the United States, regarding the imprisonment and proposed liberation of the said Wm. J. Kelley. Presented June 12, 1914.—*Mr. Carvell.*
Not printed.

DEPARTMENT OF THE INTERIOR, CANADA.
WATER POWER BRANCH
J. B. Challies, Supt.

WATER RESOURCES PAPER No. 7.

REPORT

ON

MANITOBA WATER-POWERS

Prepared under the direction of the Superintendent of Water Powers.

BY

D. L. McLEAN, S. S. SCOVIL and J. T. JOHNSTON.

COMPILED FOR THE MANITOBA PUBLIC UTILITIES COMMISSIONER

PRINTED BY ORDER OF PARLIAMENT

OTTAWA
PRINTED BY J. DE L. TACHÉ, PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1914

[No. 25e—1914.]

To His Royal Highness Field Marshal Prince Arthur William Patrick Albert, Duke of Connaught and of Strathearn, K.G., K.T., etc., etc., etc., Governor General and Commander-in-Chief of the Dominion of Canada.

MAY IT PLEASE YOUR ROYAL HIGHNESS:

The undersigned has the honour to lay before Your Excellency the report on Manitoba Water-powers by the Engineers of the Dominion Water Power Branch.

Respectfully submitted,

WM. J. ROCHE,
Minister of the Interior.

OTTAWA, February 12, 1914.

DEPARTMENT OF THE INTERIOR,
OTTAWA, February 12, 1914.

The Honourable WM. J. ROCHE,
Minister of the Interior.

SIR,—I have the honour to submit the report on Manitoba Water-powers by the Engineers of the Dominion Water Power Branch, and to recommend that it be published.

I have the honour to be, sir,
Your obedient servant,

W. W. CORRY,
Deputy Minister of the Interior.

WATER POWER BRANCH,
OTTAWA, February 11, 1914.

W. W. CORY, Esq., C.M.G.,
Deputy Minister of the Interior.

SIR,—I beg to submit herewith the report on Manitoba Water-powers by the Engineers of the Dominion Water Power Branch, and would recommend that it be published, and that a sufficient number of copies be printed to permit of its being widely distributed among those interested in the question of water-power development in Canada.

Respectfully submitted,

J. B. CHALLIES,
Superintendent of Water Power Branch.

DEPARTMENT OF THE INTERIOR,
WATER POWER BRANCH,
UNION BANK BUILDING,
OTTAWA, December 12, 1913.

To His Honour, Judge H. A. ROBSON,
Public Utilities Commission, Winnipeg.

SIR,—By direction of the Honourable W. J. Roche, Minister of the Interior, I beg to submit the following report respecting the physical features of the water-powers within the province of Manitoba, which you have requested to be prepared by the engineers of the Water Power Branch, who have been making a systematic study of water-power and stream flows throughout the province.

In brief, the report shows that the power possibilities of the smaller rivers of the province are limited and of local importance only. The main sources of dependable power in commercial quantities are: The Winnipeg river, Grand rapids on the Saskatchewan river, and the large rivers of the north, including the Churchill, Nelson and Berens.

The power possibilities of the far northern rivers are enormous, and will surely be of great moment in the future development of Manitoba's hinterland. Little is known of these northern rivers—and results from reconnaisance surveys only—however, there are sufficient reliable data to indicate that enormous amounts of dependable power, feasible of development, simply awaits a market to be harnessed.

Fortunately the drainage basins of the Winnipeg and the English rivers, lying within easy transmission distance of the present commercial centres of Manitoba, can furnish sufficient hydro-electric energy to meet any anticipated power requirements of the present settled portions of the province.

The increase in efficiency of electrical machinery, the greater distance to which energy can be transmitted, the advance generally in the electrical industry, the already great and ever-increasing cost of good steam coal (a matter of special importance to Manitoba), all tend to make the development of dependable water-power in the province of Manitoba unusually attractive.

Furthermore, the constant growing demand for hydro-electric energy for manufacturing, transportation and municipal purposes in and around the city of Winnipeg, has made the question of power development on the Winnipeg river one of the most important administrative matters occupying the attention of the Department of the Interior.

Fortunately, a well-considered and cautious policy of water-power administration has been determined upon, and regulations put into force (see chapter 9) which afford every reasonable protection to the public in the way of limited grants, rentals and control of rates, both subject to periodic revision, and at the same time providing sufficiently attractive opportunities for investment to actively interest the capitalist.

Consistent with the policy of the Dominion Government, the Minister of the Interior has instructed that all vacant Dominion land contiguous to power sites on

the Winnipeg river, or any other river in Manitoba, be reserved for disposition only under the water-power regulations referred to.

It was early found necessary, in connection with the consideration of sundry applications for power privileges on the Winnipeg river in Manitoba, for the Water Power Branch to have extensive power and storage studies made of that portion of the Winnipeg river within the province of Manitoba. These investigations show that at eight distinct power sites, by means of storage easily and cheaply accomplished at the Lake of the Woods, at Lac Seul and other lakes in the province of Ontario, it is possible and economically feasible to develop over 409,700 continuous 24-hour horse-power, all within eighty miles of the city of Winnipeg, and within feasible transmission distance of all commercial centres of the present settled portions of the province.

Of the eight possible power sites on the Winnipeg river, there are three now under development, representing a total power capacity of 199,000 24-hour horse-power. One site is completely developed by the Winnipeg Electric Railway Company on the Pinawa channel, and produces about 26,500 horse-power under most favourable conditions. Another site at Pointe du Bois falls, developed by the city of Winnipeg, produces at the present time about 20,800 horse-power, but is capable of extensions to a maximum of 77,000 24-hour horse-power. Development at the third power site at Great falls, having a maximum possible development of 95,500 24-hour horse-power, is about to be commenced.

There is, therefore, at the present time about 47,300 horse-power produced on the Winnipeg river, and transmitted for use in and around the city of Winnipeg, which can, with the two present plants, be increased to 103,500 24-hour horse-power.

The five remaining power sites on the Winnipeg river are under the control of the Dominion Government, and can furnish a further amount of 24-hour power to a maximum extent of 210,700 horse-power.

In addition, there are several important power sites on the Winnipeg and English rivers within the province of Ontario, which are within easy transmission distance of Winnipeg.

Surely this abundance of dependable and economically feasible power spells an assured industrial future for the province of Manitoba, and especially for the cities of Winnipeg, Portage la Prairie and Brandon.

It is interesting to note that the Winnipeg river, in its natural condition, forms one of the most notable power rivers in the world, having a total drop in the province of Manitoba of 271 feet, and in average years its maximum flowage being only about four times its minimum—about 12,000 cubic feet per second. Full information regarding the enormous potential power resources of the river is set out in detail in chapter 3, by Mr. J. T. Johnston, hydraulic engineer of the Water Power Branch, under whose direction the surveys and investigations of the branch have been carried on. Particular attention is called to the two diagrams on plates 9 and 10, which illustrate graphically the power situation on this river under conditions of regulation and non-regulation.

The preparation of the material in this report, excepting that relating to the Winnipeg river, was commenced by Mr. D. L. McLean, chief engineer of the Manitoba Hydrographic and Power Surveys, but owing to his resignation from the department in October last, to accept a position with the engineering staff of the city of Winnipeg, most of the work has developed upon Mr. S. S. Scovil, assistant chief engineer, to whose energy and resourcefulness is due a great measure of credit for the compilation of the material in the short time available.

It might seem pertinent to put on record more complete data bearing on the hydrology and other natural phenomena of the river basins of Manitoba which the engineers of the Water Power Branch have collected, collated and compiled, but these data will shortly be published in a forthcoming report of the work of the Manitoba Hydrographic and Power Surveys, and, furthermore, the limited time available for the completion of this report prevents satisfactory deductions therefrom. It has therefore been considered advisable to furnish general hydrographic data only, and to suggest that persons desiring to pursue questions of water supply further should either communicate with the chief engineer of the Manitoba Hydrographic and Power Survey or await the issue of the report referred to.

It is regretted that the limited time available for the preparation of this report—due to the necessity of having it placed in your hands by the 15th of December—has prevented a more complete and careful compilation of the available material regarding the physical features of power in Manitoba.

I have the honour to be, sir,

Your obedient servant,

J. B. CHALLIES,

Superintendent of Water Power Branch.

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WATER-POWERS OF MANITOBA

CHAPTER 1

GENERAL SUMMARY OF POWER SITUATION IN MANITOBA

CHAPTER 1.

GENERAL SUMMARY.

That Manitoba is richly endowed with numerous water-powers has been generally known, but previous to the investigations of the Water Power Branch of the Department of the Interior of Canada, their extent and magnitude have only been approximated.

Recognizing the great value of such powers, and with a view to the power requirements of both the present and future, a complete study has been made of certain power rivers, and is being made of all other power rivers throughout the province. In such studies it is the aim of the department to form a comprehensive scheme contemplating the maximum development of the total head available upon a river.

The great power possibilities of Manitoba are due to the geological and topographical features of the province. The central portion of Manitoba acts as a collecting basin for the waters from an immense drainage area. This vast area extends from the Rocky mountains practically as far eastward as lake Superior; it also comprises a great portion of the Northern States and reaches into the northerly lands of Western Canada.

As these waters reach the central portion of the province, a depression occurs between the prairie steppes and the Laurentian plateau, through which an extensive fall is available for power development. Lake Winnipeg forms the reservoir into which is collected practically all the run-off from the above described drainage area. From this lake to Hudson bay the flow is concentrated in the Nelson river, on which a drop of approximately 700 feet occurs.

From the above it is apparent that the major portion of the powers throughout the basin are concentrated within the lower portion of the drainage area, or more particularly in Manitoba.

The powers are naturally separated into two divisions, viz., those occurring on the rivers draining into lake Winnipeg, which are situated in the older or southern portion of the province, and secondly, the powers which occur in the northern portion lying in the drainage from lake Winnipeg. Under these two divisions the estimated powers of the province are tabulated below.

It should be noted that while, on many rivers, possible power concentrations have been investigated and an estimate of the available power is given for various sites, yet as future investigations will show, further power may be available on such rivers. Again, in the case of other rivers, no surveys to determine the extent of concentration available have as yet been made, and in these cases where a record of the flow has been obtained, an estimate is made of the power available per foot head. In many cases the power has been estimated both for the extreme minimum flow and for the lowest monthly mean flow of the highest six months of the year, as obtained from the present record of discharges.

The horse-power has been calculated for a turbine efficiency of 80 per cent, while no estimate has been made as to the power available during short periods of high or peak loads, since this would be impossible without a knowledge of the circumstances for which the power might be desired. The powers on the Winnipeg river have been considered on a 75 per cent efficiency basis, for reasons set out in the chapter on that river.

The data for these tables, and also for the more detailed description of the rivers as given in the following chapters, have been secured in the field by the Manitoba

Hydrographic and Power Surveys, and office compilation in Winnipeg and Ottawa. The power surveys carried out and the gauging stations maintained by the above surveys are shown on plate No. 34.

The following tabulation of the powers in the province is not intended to fully cover the subject, as many rivers are as yet to be investigated:—

TABLE No. 1.

1.—POWERS OF SOUTHERN AND CENTRAL PORTION OF PROVINCE.

(a) Existing Water-Power Developments.

River.	Plant.	Power Developed.
		* Horse Power.
Winnipeg	City of Winnipeg	20,800
"	Winnipeg Electric Railway Co.	26,500
Little Saskatchewan	Brandon Electric Light Co	500
" "	Minnedosa Power Co.	500
Shell	Assessippi	50
Total		48,350

*The city of Winnipeg plant can ultimately supply, with a regulated river, 76,800 24-hour power.

TABLE No. 2.

(b) Possible Water-Power Developments.

WINNIPEG RIVER.

Site.	Head.	24-HOUR POWER AT 75 PER CENT EFFICIENCY.	
		12,000 sec.-ft.	20,000 sec.-ft.
Slave Falls	26	26,600	44,400
First Site, Seven Sisters	39	11,600	34,800
Second Site, Seven Sisters	37	12,600	37,900
McArthur	18	18,400	30,700
Du Bonnet	56	57,300	95,500
Pine	37	37,900	63,100
Totals		164,400	306,400

TABLE No. 3.

River.	Site.	HORSE-POWER ON 80 PER CENT EFFICIENCY, 24 HOURS.					
		Min. flow.	Total.	Reg. flow.	Total.	Period of six highest mos. of yr.	Total.
Whitemouth	No. 1	46				180	
"	No. 2	46	92			180	360
Brokenhead	X	0				8	
Roseau	X	0				3·6	
Red	t. Andrews					3,270	3,270
Pembina	X						
Souris	X	0·5				4·5	
Shell	X					18	
Assiniboine	Currie's Landing	653				1,685	1,685
"	Headingly	36				108	
"	Millwood	14				64	
Little Saskatchewan	No. 1	180		840			
"	" 2	203		945			
"	" 3	212		987			
"	" 4	90	685	420	3,192		
Valley	" 1	34		102		172	
"	" 2	34		102		172	
"	" 3	101		303		504	
"	" 4	94	263	282	789	468	1,316
Mossy	" 1	455					
"	" 2	455	910				
Waterhen	Meadow Port	6,800					
Fairford and Dauphin	No. 1	3,630					
"	" 2	2,950					
"	" 3	12,706					
"	" 4	7,260	26,546				
Swan		4·5				14·5	
Red Deer		13·7					
Manigotagan	No. 1	90		449			
"	" 2	22		109			
"	" 3	33		163			
"	" 4	82		408			
"	" 5	33		163			
"	" 6	49		245			
"	" 7	92		462			
"	" 8	76		382			
"	" 9	57		286			
"	" 10	74	608	368	3,034		
Saskatchewan	Demi Charge	6,808				46,289	
"	Red Rock	6,808				46,289	
"	Grand Rapids	36,305	49,921			246,877	339,455

The estimated power as shown refers only to horse-power per foot head, as investigations as to possible concentrations are as yet to be made.

TABLE No. 4.

Powers of Northern Portion of Province.

River.	Site.	Horse Power based on 80 per cent Efficiency. Estimated Minimum Flow, 50,000 sec. ft.
Nelson	Whisky Jack portage	181,150
"	Ebb and Flow rapids	77,150
"	White Mud rapids	135,860
"	Bladder rapids	90,575
"	Chain of Rock rapids	158,510
"	Devil's rapids	113,220
"	Grand rapids	122,530
"	Birthday rapids	163,375
"	First Gull rapids	77,150
"	Second Gull rapids	95,105
"	Third Gull rapids	90,575
"	Fourth Gull rapids	135,860
"	First Kettle rapids	77,150
"	Second Kettle rapids	97,370
"	Third Kettle rapids	181,150
"	Upper Long Spruce rapids	181,150
"	" "	235,495
"	Upper Limestone rapids	149,450
"	Lower Limestone rapids	185,680
		2,548,505

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WATER-POWERS OF MANITOBA

CHAPTER II

HYDROLOGY

CHAPTER II.

RAINFALL, EVAPORATION AND RUN-OFF.

General.

Two main factors enter into the investigation of any possible power development—the head and flow available. While the first of these is obtainable through field survey and a knowledge of the extreme and average stages of river level, yet the second comprises an extensive study of the flow which, dependent on natural conditions, varies not only with the season and year, but also with the topography and character of the drainage area. Primarily, all waters carried by rivers comes from the rainfall or the melting of snow which has been precipitated during the winter months. Of this rainfall a portion evaporates, a portion enters the soil and is either absorbed by plant growth or, by ground flow reaches the rivers or lakes, while the third portion finds its way into streams as surface flow or run-off.

Rainfall.

While the record of the run-off from a drainage area is of first importance in the question of power development, yet the rainfall or precipitation is also of extreme value in that these latter records, if of a more extensive period than those of the run-off, would indicate the high and low range of flow which might be expected. In a like manner, rainfall records in a drainage basin in which no discharge measurements are available can be used for the estimation of the flow based on the rainfall and run-off records of an adjacent area.

Throughout the southern portion of the province of Manitoba, rainfall records have been obtained by the Meteorological Bureau of the Marine and Fisheries Department of Canada, and these records are tabulated for the various stations on Plate No. 1.

It is well known that the precipitation not only shows a variation from season to season, but also that a record extending over a short period of years is not sufficient to give the mean annual rainfall, but rather that for this mean a period of cycle of long term should be considered. As the stations throughout the province at which long-term records have been obtained are not numerous, it is necessary to carry out some system of compensation for the shorter records of the adjacent stations. As is shown on the curves on plates No. 2 and No. 3, the records of the rainfall at the long-term stations, shown separately for the eastern and western portions of the province, have the same general features from period to period. Assuming that the intermediate stations of shorter terms will also range in a like manner from periods of heavy to those of light precipitation in the same years as at the long-term stations, the probable ratio of these short-term records to that of a long term for the same station, has been based on the ratio of the precipitation at an adjacent long-term station during similar years, to the precipitation of the total period of the long-term station. As shown on plates No. 2 and No. 3, the precipitation, together with the duration of the record, are given for various stations throughout the province. The ratio of all short-term records has been computed from the nearest long-term station as tabulated in the table, and a compensated annual mean for the station has been calculated. From these

compensated results, the location of lines of equal precipitation has been determined and are shown for the southern portion of the province on plate No. 34. In the preparation of this isohyetal map it will be noted that it has been necessary to use several records of very short period, but, in the main, these records have been found to verify the lines of equal rainfall between the long term stations.

Evaporation.

Of the tremendous losses due to evaporation from the ground surface, very little is known. It is impossible to arrive at such losses by taking the difference between rainfall and run-off, as in this there would also be included the losses due to absorption by the soil and by vegetation, and again the rate of run-off does not depend altogether upon the rainfall. It is known, however, that a variation does occur in the evaporation depending upon many factors in which are comprised atmospheric conditions, geological and topographical features of the drainage basin, together with the extent of forestration and vegetation.

A more complete study has been made of the evaporation from the water surface of lakes and rivers, the greatest use of such studies being in the investigation of storage and the losses which are likely to occur on such reservoirs through evaporation. That the losses on lake areas are very great, and often of greater extent than precipitation, is well known.

In connection with the investigation of the water-powers on the Winnipeg river, and with the view to maximum efficiency in the development of powers thereon, it has been found necessary to consider and investigate the possibilities of conserving the flood waters. Accordingly, very complete studies are being made of the storage possibilities of the immense lake areas of the Lake of the Woods district. These studies have naturally included the securing of data with respect to evaporation, and on May 1, 1913, an evaporation station, together with numerous instruments for the recording of all atmospheric phenomena which affect the extent of evaporation, was established on the Lake of the Woods in the vicinity of Keewatin, Ont.

Run-off.

It is readily seen that the extent of run-off or stream flow depends principally upon the depth of rainfall and the area of the basin drained, yet many other factors entering therein and of extreme importance comprise such as the geological formation and topographic features of the drainage area, whether of sloping land tending to give a rapid run-off, or of low-lying swampy areas from which the flow is more or less uniform, and also dependent upon the extent of the growth of timber and vegetation, together with numerous other factors.

While much can be gained from the studies of rainfall and evaporation and the physical features of a drainage area, yet the most accurate and reliable data with regard to run-off or stream flow are obtained by a systematic gauging and metering of the flow of the stream to secure the continuous run-off, and extending over sufficient time to obtain the extreme fluctuation. The run-off of any stream varies not only from season to season, but also to such an extent from year to year that the same conditions are not likely to occur on a river in any two successive years. Records for a cycle of at least seven years are, as a rule, necessary to cover the yearly variation to be anticipated.

Not only is the study of the run-off of streams of extreme importance in the investigations of power possibilities, but it is also of extreme value in the investigation of possible reclamation of low lands through drainage, or the reclamation of arid lands through irrigation. Such a study is also necessitated on many rivers where schemes for the betterment of navigation are proposed.

SESSIONAL PAPER No. 25e

MANITOBA HYDROGRAPHIC SURVEY.

Previous to the year 1911, there had been no systematic or reliable gathering of data relating to the flow of the rivers in the province of Manitoba. Some few scattered discharge measurements had been made throughout the province, but not of sufficient extent to give information as to the continuous flow of any rivers as extending over various stages of their discharge. In the above year a systematic study of the power possibilities of the Winnipeg river was inaugurated by Mr. J. B. Challies, Superintendent of Water Power Branch, Department of the Interior of Canada. The field work, of which Mr. D. L. McLean was in charge, consisted of a detail survey of the river and its power possibilities in Manitoba, and also included the establishment and maintenance of gauging stations on the river. This work, in the spring of 1912, was further enlarged so as to embrace a systematic study of the flow and power possibilities of all rivers throughout the province. For this extensive work, the Manitoba Hydrographic Survey was organized, with the appointment of Mr. D. L. McLean as chief engineer, the work still being carried on under the supervision of the Water Power Branch. Numerous gauging stations were established on the rivers and streams throughout the province, and since that time the gathering and compiling of the data has been vigorously carried on. The various metering and gauging stations at present maintained, together with the extent of the power surveys of the province, are shown on the plan on plate No. 34.

PLATE 1.

MANITOBA HYDROGRAPHIC SURVEY.

MANITOBA RAINFALL RECORDS.

THIS TABLE has been compiled from the Meteorological Service Records; 10 inches of snow has been assumed equal to 1 inch of rainfall.

Station.	Elevation.	Duration of Record.	Years.	Annual Mean.	Long term Mean based on Record.	Probable ratio of Rainfall in this period to long term Mean.	Compensated annual Mean for this station.
				Inches.	At.	p.c.	
Almasippi		1903—1912	10	20·90	Winnipeg	100	20·9
Asessippi		1886	1	13·52	Minnedosa	65	18·3
Adelphi		1888—1912	1	12·25	Bottineau, N. Dak.	86	14·0
Brandon	1,176	1885—1912	21	17·16		100	17·2
Birtle	1,703	1884	1	25·40	Hillview	130	17·8
Barnardo		1891—1905	9	16·80	"	122	13·1
Berens River	710	1908—1912	5	21·22			
Beausejour		1886—1888	3	15·09	Winnipeg	52	22·3
Burnside		1886—1890	4	14·95	Stony Mountain	70	19·4
Craigilea		1888	1	15·05	Winnipeg	78	18·4
Channel Island		1890—1905	15	17·10	Stony Mountain	73	21·7
Cartwright	1,533	1884—1912	15	19·82	Bottineau	123	15·3
Clarkleigh		1886—1888	3	18·10	Stony Mountain	86	20·6
Carberry	1,258	1909—1911	3	17·07	Minnedosa	90	18·8
Clandeboye		1884—1888	4	16·72	Stony Mountain	72	21·4
Elkhorn		1895—1901	4	17·81	Hillview	115	15·1
Emerson		1894—1898	3	21·67	Pembina, N. Dak.	106	20·4
Eden		1884—1887	4	17·14	Minnedosa	74	21·6
Fort Ellice		1885—1891	7	15·25	Hillview	99	15·4
Gretna	760	1903—1910	8	18·67	Pembina, N. Dak.	94	19·8
Gilrad		1904—1905	2	11·77	Bottineau	93	12·6
Hillview	1,400	1891—1912	20	20·00	Minnedosa	114	17·2
Minnedosa	1,690	1881—1912	32	17·82		100	17·8
Morden	978	1888—1912	17	19·69	Pembina, N. Dak.	93	21·1
Norquay	798	1888—1912	16	19·00	Winnipeg	85	21·9
Oakbank	740	1886—1912	22	21·04		100	21·0
Oakdale Park	740	1905	1	18·48	Minnedosa	110	16·6
Portage la Prairie	830	1884—1908	14	17·00	Winnipeg	93	18·2
Pilot Mound	1,547	1887—1898	4	18·74	Pembina	93	20·1
Rapid City	1,180	1882—1912	15	17·65	Minnedosa	91	18·2
Russell		1884—1904	9	15·18	Hillview	89	16·8
St. Albans	1,060	1885—1912	25	17·66		100	17·7
Swan River		1901—1910	4	20·85			
Shell River		1884—1890	6	15·37	Minnedosa	89	16·9
Stony Mountain	803	1878—1909	22	17·64	Winnipeg	83	20·6
Turtle Mountain	2,150	1884—1904	12	21·92	Bottineau	141	12·9
Treherne	1,212	1910—1912	3	18·28	Winnipeg	93	19·6
Winnipeg	760	1873—1912	40	21·55		100	21·6
Kenora (Ont.)		1886—1912	9	22·41	Winnipeg, P. Arthur	93	24·0
Norway House		1895—1904	8	18·90			
York Factory		1875—1882	3	20·38			
Moosomin (Sask.)		1901—1905	3	17·39	Hillview	113	15·1
Saltcoats (Sask.)		1900—1903	4	15·69	Hillview	122	12·2
Port Arthur (Ont.)		1886—1912	27	23·08			

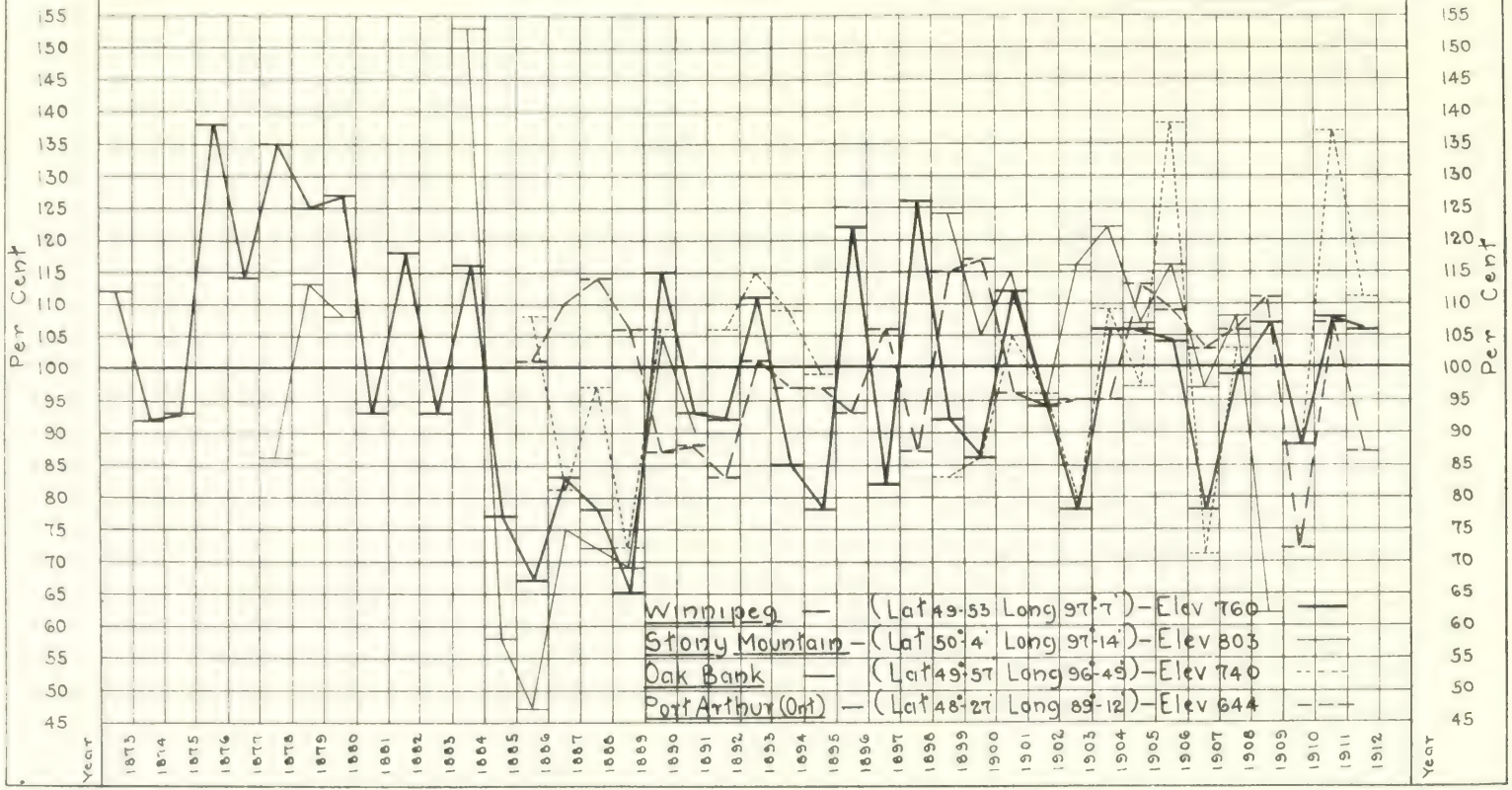
November, 1913.

MANITOBA HYDROGRAPHIC SURVEY

MANITOBA RAINFALL RECORDS

Curves showing relation of precipitation at long term stations

Winnipeg. November 1913.



MANITOBA HYDROGRAPHIC SURVEY

MANITOBA RAINFALL RECORDS

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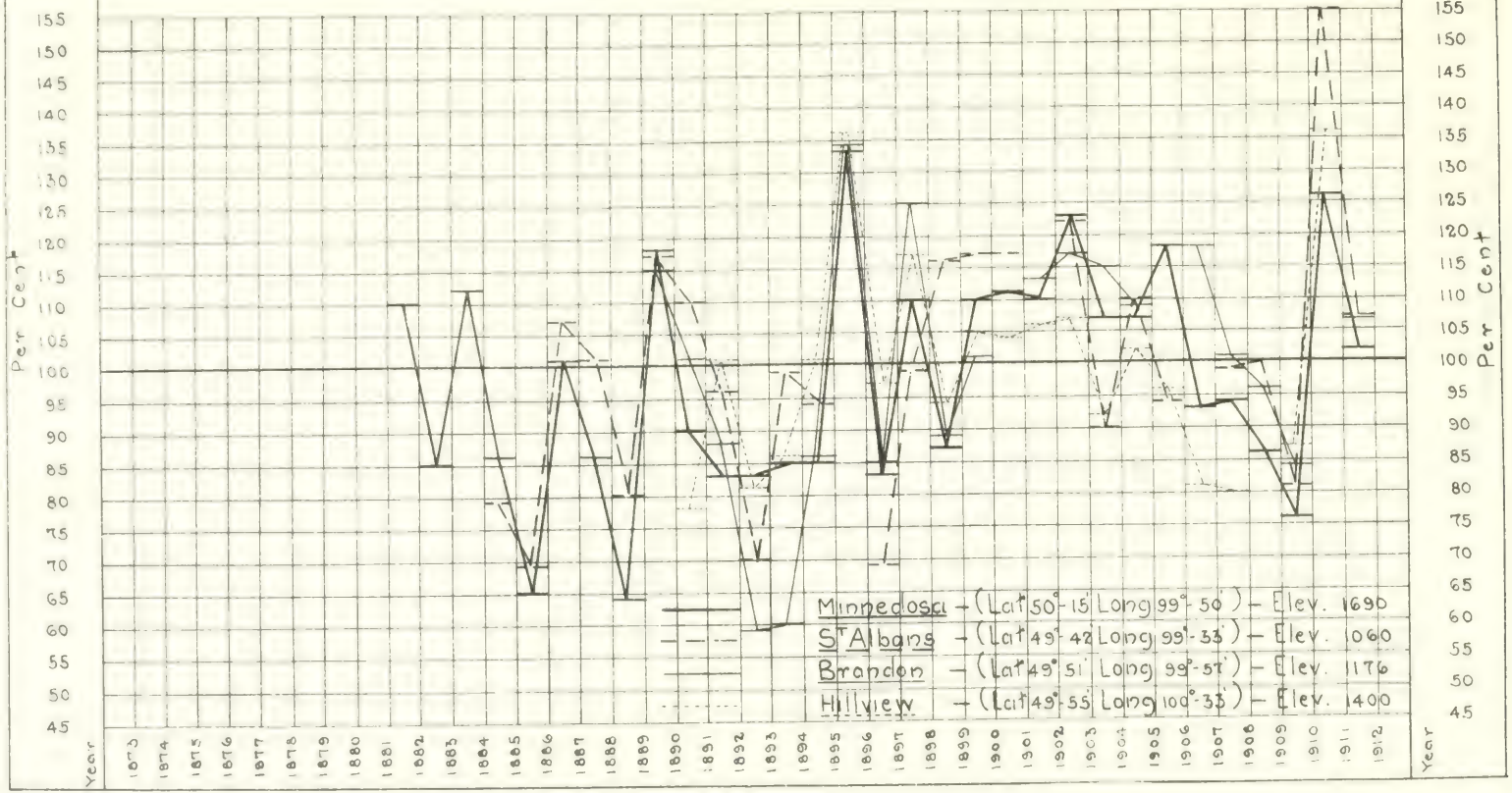


WATER-POWERS OF MANITOBA

CHAPTER III

WINNIPEG RIVER

CHAPTER III

WINNIPEG RIVER.

1. Necessity for Investigation.

It has long been recognized that there is an enormous reserve of potential water-power on the Winnipeg river within the province of Manitoba. The rapidity with which the existing developments on the river have been, and are being increased to their capacity, and the active interest that has been taken in the undeveloped power sites of the river, have compelled the Dominion Government to give the water-power resources on this river careful and full consideration. Within the last few years there have been presented to the Dominion Government many applications for power privileges on this river; schemes have been proposed for the utilization of various portions of the natural fall, some contemplating the combination of several falls by the concentration of their respective drops at one power site, and others simply proposing the utilization of the drop at a particular fall. These have been so varied and so conflicting, and at the same time supported by such reputable engineering advice, that the government found it inadvisable to commit itself with respect to any further developments on the river until it had first caused to be made a complete survey and investigation of the whole river, with a view to securing such information as would enable the dictation of developments which would contemplate the maximum possible advantageous utilization of the water-power resources of the river. These investigations were started early in the year 1911, under the consulting advice of Mr. J. B. McRae, C.E., of Ottawa, and the field work has proceeded vigorously to completion under charge of Mr. D. L. McLean. For the purpose of this report for the Public Utilities Commission, which had to be completed by December 15, plans based on this field work have been rushed to completion, and a preliminary provisional estimate made by the engineers of the Water Power Branch, of the best method of concentrating the various separate falls of the river to enable all the natural fall to be utilized for power purposes, and at the same time have each unit development a component part of the comprehensive scheme for the whole river. These concentrations are indicated in plan and profile on plates No. 6 and No. 7. A study of this profile will illustrate the completeness with which the objects of the investigation have been realized, and the full conservation of the power resources of the river provided for.

2. Description of River and Drainage Basin.

The Winnipeg river is one of the most notable power rivers on the continent; it flows in a westerly direction, connecting the Lake of the Woods with lake Winnipeg. The basin drained (see plate No. 4), comprises an immense area of some 55,000 square miles, lying at the westerly end of the Laurentian plateau. As is typical of Laurentian country, the area is dotted with innumerable muskegs and lakes, the latter varying in size from small ponds to the Lake of the Woods, with an area of 1,500 square miles. Certain general characteristics apply to the drainage basin as a whole, since practically the entire area is of Laurentian formation with an overlying soil of glacial origin. The country is rough and hilly, with large areas of rock outcrop. This latter feature applies in the main throughout the Winnipeg river, and lends itself to a characteristic formation throughout the river channel, which is of exceptional value

in the interests of power development. The larger proportion of the river bed in the province of Manitoba, consists of a series of deep cup-like basins, forming small lake-like expanses with little or no current. The river flow finds its way from these basins by falls and rapids over the rock formation which is always in evidence at the outlets, and which forms at once the means of egress from and the controlling feature of the basin water level. These falls form the natural power sites along the river.

A valuable timber growth, including spruce, tamarack, birch and pine occurs throughout the whole district. Lumbering is carried on extensively and, in addition, pulp and paper industries have been established at Fort Frances and Dryden. Notwithstanding the great extent of rock outcrop, considerable area is available for farming, this applying more especially to the Whitemouth and Rainy River districts. While there are several prosperous towns, such as Fort Frances, Rainy River and Kenora in the basin, yet the greater portion of the country has not been settled, and is still in the state of nature.

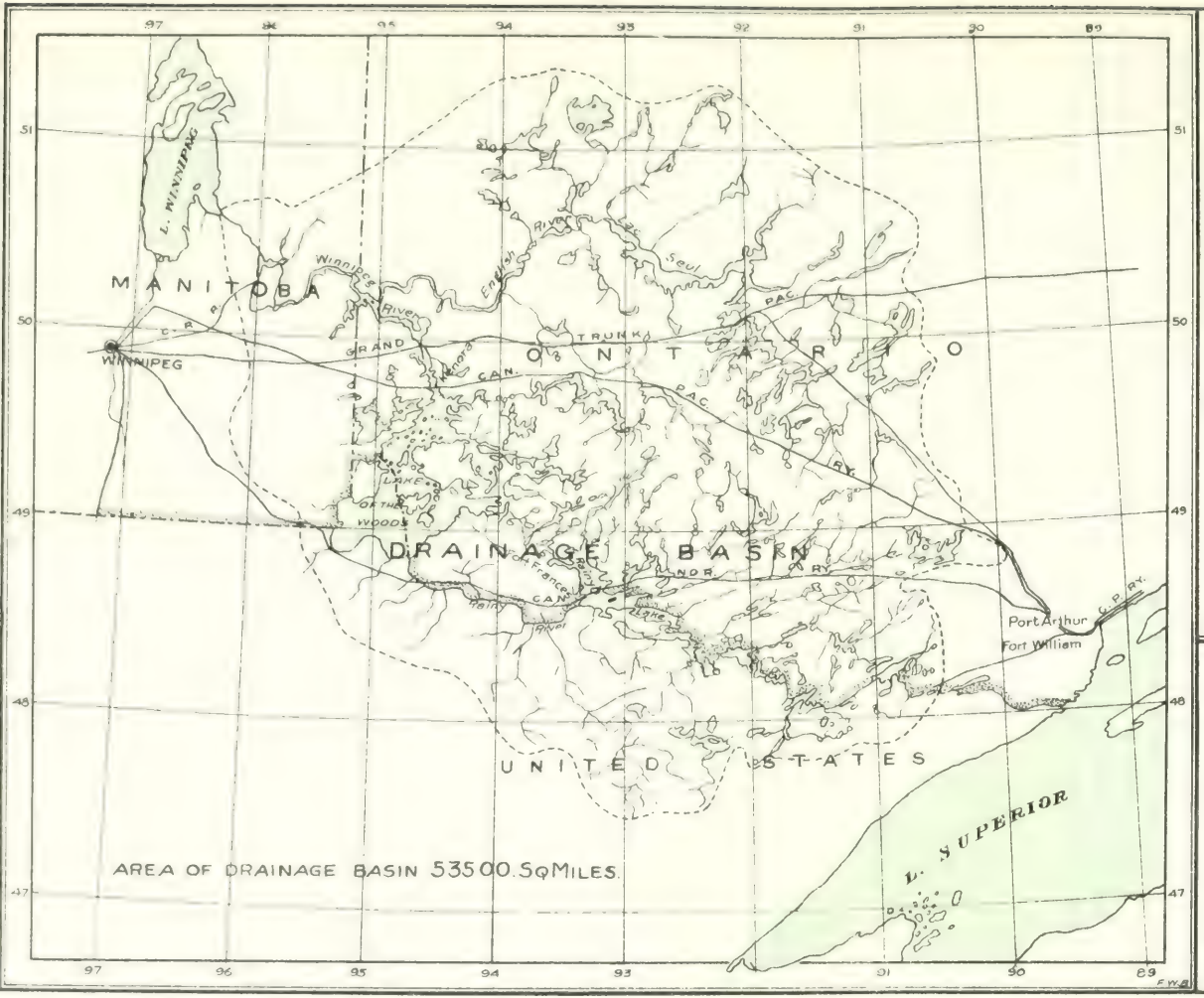
The upper watershed reaches to the height of land separating the Atlantic drainage from that of Hudson bay, into which the waters of the Winnipeg river eventually flow. North lake, which is situated on the international boundary, some forty-five miles west of lake Superior, is the head-water of the drainage basin. From North lake the stream flows westward, passing through many small lakes, collecting the flow of numerous tributaries and finally discharging into Rainy lake. These upper waters, in the main, constitute a portion of the International boundary. Many streams heading in upper lakes and muskegs also contribute to the flow from Rainy lake. This latter has a surface of 330 square miles, and a drainage area of some 14,600 square miles. Rainy river, which is the outlet, discharges into the Lake of the Woods. From this latter lake to lake Winnipeg, the river is known as the Winnipeg. Forty miles down the river from the Lake of the Woods, the flow of the English river enters that of the Winnipeg. This tributary is almost of as large dimensions as the river into which it flows, as it drains an area of 22,000 square miles, while the Winnipeg, at the Lake of the Woods outlets, has a drainage of 25,000 square miles. From the Lake of the Woods to Lake Winnipeg, there is a total drop of 341 feet, and of this 70 feet takes place above and 271 feet below the junction with the English river; as this junction occurs practically at the boundary between Ontario and Manitoba, it follows that the combined flow of the two rivers, together with the greater drop as noted above, are available for power purposes in Manitoba. Of this head a considerable portion is already being utilized by existing developments on the river.

3.—Flow Records.

Estimates of the daily flow of the Winnipeg river have been compiled by the Manitoba Hydrographic Survey, based on the discharge measurements secured by them, together with results of measurements supplied by Col. Ruttan, D. A. Ross, and the city of Winnipeg power engineers. These estimated discharges, which are given in tables No. 5 to 24, are referred to the flow of the river at Pointe du Bois and extend over a period of six years. For this period a maximum flow of 53,400 second-feet and a minimum flow of 11,700 second-feet have been recorded. The high-water marks along the shore would indicate that floods of 100,000 second-feet have occurred in the past. Such floods must, however, take place at rare intervals.

4.—Storage on the Upper Waters.

The question of storage on the upper waters of the Winnipeg river is at present somewhat involved, in that the regulation of the Lake of the Woods has become an international question, and is now before the International Joint Commission. Con-



DEPARTMENT OF THE INTERIOR, CANADA.

WATER POWER BRANCH.

J.B. CHALLIES. SUPT.

MANITOBA POWER SURVEY.

WINNIPEG RIVER

PLAN SHOWING

ENTIRE RIVER BASIN

Scale. 50 Miles = 1 inch.

Compiled for The Manitoba Public Utilities Commission

Date. Nov. 27th 1913

sidering that the lake has a tributary drainage area of 25,000 square miles and a surface area of 1,590 square miles, offering unexcelled storage facilities, it is of vital importance to the powers of the Winnipeg river that storage should be had on this lake. Partial regulation of the drainage tributary to Rainy lake is now controlled on Rainy lake by the dam of the Ontario and Minnesota Power Company at Fort Frances.

By the establishment of storage reservoirs on the English river, the flow of the latter can be regulated; and in conjunction with storage on the Lake of the Woods drainage basin, practically a complete regulation of the flow of the Winnipeg river in Manitoba can be attained.

During the period of the last six years, over which records of the flow of the Winnipeg river extend, a minimum flow of 11,700 second-feet has been recorded, while the maximum flow in the same period is 53,400 second-feet, a range of only 1 to 4, which is illustrative of the extremely low fluctuation under practically natural conditions. By an adequate system of storage, this flow can be so regulated that the minimum flow will be readily increased from about 12,000 second-feet to over 20,000 second-feet. On plate No. 5 is shown a mass curve of the flow of the river at Pointe du Bois for the period from January 23, 1906, to December 31, 1912. For this period a storage of 373 billion cubic feet would have been necessary for a complete regulation.

TABLE No. 5.

Discharge Measurements of Winnipeg River near Pointe du Bois, Man., 1906.

Date.	Hydrographer.	Gauge Height.	Discharge.
		Feet.	Sec.-ft.
March 7.	C. L. Ruttan	160·5[1]	12,876[2]

[1]Referred to lower gauge at Pointe du Bois.
[2]Just above falls at Pointe du Bois, one foot ice cover. Gauge height approximated.

TABLE No. 6.

Discharge Measurements of Winnipeg River near Pointe du Bois, 1907.

Date.	Hydrographer.	Gauge Height.	Discharge.
		Feet.	Sec.-ft.
Aug. 1	Pratt and Ross for Winnipeg Street Railway Company	162·2	31,047[1]
2	"	162·2	30,600[2]
Oct. 31	"	164·2	41,300[3]

Gauge heights referred to lower gauge at Pointe du Bois.

[1]Below diversion dam and Pinawa channel. Two channels measured to give total.
[2]Barrier chute.
[3]Otter Falls.

TABLE No. 7.

DISCHARGE MEASUREMENTS of Winnipeg River near Pointe du Bois, 1908.

Date.	Hydrographer.	Gauge Height.	Discharge.
		Feet.	Sec.-ft.
July 14	Pratt and Ross for Street Railway Company	164.2	43,000
Nov. 7	" " "	162.0	28,700

Gauge heights referred to lower gauge at Pointe du Bois.
Discharge measured at Otter Falls.

TABLE No. 8.

DISCHARGE MEASUREMENTS of Winnipeg River near Pointe du Bois, 1909.

Date.	Hydrographer.	Gauge Height.	Discharge.
		Feet.	Sec.-ft.
May 24	Pratt and Ross for Street Railway Co.	161·0	26,360
July 17	do do	161·25	26,000
Oct. 8	do do	160·70	22,500
Nov. 8	do do	160·55	21,770

Gauge heights referred to lower gauge at Pointe du Bois.
Discharge measured at Otter Falls.

TABLE No. 9.

DISCHARGE MEASUREMENTS of Winnipeg River near Pointe du Bois, 1910.

Date.	Hydrographer.	Gauge Height.	Discharge.
		Feet.	Sec.-ft.
July 28	Pratt and Ross for Street Railway Co.	162·25	29,375

Gauge heights referred to Lower Gauge at Pointe du Bois,
Discharge measured at Otter Falls.

TABLE No. 10.

DISCHARGE MEASUREMENTS of Winnipeg River near Pointe du Bois, 1911.

Date.	Hydrographer.	Meter No.	Width.	Area of Section.	Mean Velocity.	Gauge Height.	Discharge.	
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.	
Feb. 4, 6, 7....	Stamford (for city of Winnipeg)..		280·5	5,475	2·26	159·26	12,375	[1]
Feb. 13, 14, 15.	do		....	5,691	2·28	159·26	13,256	[1]
May 7	Pratt and Ross (for Street Railway Co.)					159·42	13,450	[1]
May 19	do					159·87	15,800	[2]
Oct. 13, 14....	A. M. Beale (Water Power Survey).	3	269	7,272	3·59	161·80	26,115	[1]
Oct. 24	do	1	2·9	7,218	3·68	161·70	26,391	
Dec. 6, 7, 8, 9.	A. M. Beale and Alex. Pirie....	1	610	21,910	1·10	160·68	24,145	[4]
Dec. 6, 7, 8, 9.	do	1	610	21,910	1·11	160·68	24,320	[5]

Gauge heights referred to lower gauge at Pointe du Bois.

[1] City meter station 10 miles below Pte. du Bois, Man., section, ice, cover; check measurements.
[2] Otter Falls, ice measurement.
[3] Slave falls.
[4] 1½ miles above Gd. du Bonnet falls, 0·2 and 0·8 method under ice.
[5] 1½ miles above Gd. du Bonnet falls, Vert. Vol. curve method under ice.

TABLE No. 11.

DISCHARGE MEASUREMENTS of Winnipeg River near Slave Falls, 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of Section.	Mean Velocity.	Gauge Height.	Discharge.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-Ft.
May 8	A. M. Beale	1197	260	6,761	2·91	160·52	19,675
May 14	G. H. Burnham ..	1197	264	7,014	3·26	161·20	22,865
May 28	A. M. Beale	1197	273	7,366	3·65	161·88	26,887
June 4	E. B. Patterson...	1196	264	7,542	3·85	162·15	28,036
June 6	G. H. Burnham...	1187	277	7,565	3·95	162·5	29,882
June 10	E. B. Patterson....	1197	277	7,536	3·92	162·25	29,543
June 17	W. H. Richardson.	1197	273	7,449	3·80	162·09	28,207
June 24		1197	272	7,396	3·67	161·90	27,144
July 6		1197	272	7,238	3·56	161·75	25,780
July 8		1197	271	7,237	3·55	161·78	25,692
July 11		1197	271	7,446	3·54	161·76	26,358
July 15		1197	271	7,446	3·58	161·77	26,656
July 16		1197	272	7,473	3·60	161·79	26,901
July 17		1197	271	7,473	3·51	161·80	26,453
July 18		1197	271	7,446	3·52	161·78	26,209
July 19		1197	271	7,473	3·55	161·75	26,528
July 20		1197	271	7,473	3·55	161·76	26,528
Aug. 20	Alex. Pirie..	1197	272	7,369	3·74	161·98	27,560
Oct. 23		1197	293	7,934	4·36	163·28	34,628
Nov. 21		1462	291	7,785	3·95	162·85	30,761
Dec. 21		1462	274	7,430	3·64	162·10	27,095

Gauge heights referred to lower gauge at Pointe du Bois.

TABLE

Daily Gauge Height and Discharge of

Day.	January.		February.		March.		April.		May.		June.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge H'ght	Discharge.	Gauge H'ght	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			161·80	27,860	160·4	19,180	160·6	16,700	159·6	14,400	160·8	21,660
2			·75	27,550	·4	19,180	159·9	16,100	·7	14,950	·8	21,660
3				27,550		18,560	·8	15,500	·6	14,400	·8	21,660
4			·80	27,860	·2	17,940	.7	14,950	·6	14,400	·8	21,660
5			162·0	29,100	·3	18,560	·6	14,400	·6	14,400	·9	22,280
6			162·0	29,100	160·4	19,180	159·6	14,400	159·6	14,400	161·0	22,900
7			161·8	27,860	·3	18,560	·6	14,400	·7	14,950	·2	24,140
8			·6	26,620	·4	19,180	6	14,400	·8	15,500	·2	24,140
9			·2	24,140	·2	17,940	·6	14,400	·7	14,950	·2	24,140
10				24,140		17,320	·6	14,400	·7	14,950	·2	24,140
11			161·2	24,140	160·0	16,700	159·6	14,400	159·7	14,950	161·4	25,380
12			·2	24,140	·2	17,940	·6	14,400	·7	14,950	·6	26,620
13			160·6	20,420	·2	17,940	·6	14,400	·7	14,950	·8	27,860
14			·8	21,660	·2	17,940	·6	14,400	·7	14,950	·8	27,860
15			·4	19,180	·3	18,560	·6	14,400	·7	14,950	162·0	29,100
16			160·4	19,180	160·1	17,320	159·6	14,400	159·7	14,950	·0	29,100
17				19,180	·1	17,320	·6	14,400	·7	14,950	·0	29,100
18			·3	18,560	·1	17,320	·6	14,400	·8	15,500	·2	30,340
19			·6	20,420	·1	17,320	·6	14,400	160·0	16,700	·2	30,340
20			·5	19,800	·1	17,320	·6	14,400	·1	17,320	·2	30,340
21			160·6	20,420	160·0	16,700	159·6	14,400	160·1	17,320	162·3	30,960
22			·4	19,180	159·9	16,100	·6	14,400	·2	17,940	·4	31,580
23	161·5	26,000	·4	19,180	·9	16,100	·6	14,400	·2	17,940	·5	32,200
24		26,000		19,800	·8	15,500	6	14,400	·1	17,320	·6	32,820
25		26,000	·6	20,420	·8	15,500	·6	14,400	·1	17,320	·6	32,820
26	161·5	26,000	160·8	21,660	159·8	15,500	159·6	14,400	160·2	17,940	162·6	32,820
27		26,700	·7	21,040	·8	15,500	·6	14,400	3	18,560	·6	32,820
28		27,400	·6	20,420	·8	15,500	·6	14,400	·4	19,180	·7	33,440
29	161·85	28,170			·9	16,100	·6	14,400	·5	19,800	·7	33,440
30		28,170			160·0	16,700	·6	14,400	·5	19,800	·7	33,440
31	·85	28,170			·0	16,700			·6	20,420		

SESSIONAL PAPER No. 25e

No. 12.

Winnipeg River, near Otter Falls, for 1907.

Days.	July.		August.		September.		October.		November.		December.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge H'ght	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft
1	162 7	33,440	162 2	30,340	162 9	34,680	163 6	39,020	164 2	42,740	164 2	42,740
2	8	34,060	3	30,960	163 0	35,300	6	39,020	2	42,740	2	42,740
3	8	34,060	2	30,340	0	35,300	8	40,260	2	42,740	2	42,740
4	7	33,440	2	30,340	0	35,300	8	40,260	2	42,740	2	42,740
5	8	34,060	2	30,340	0	35,300	164 0	41,500	2	42,740	1	42,120
6	162 7	33,440	162 2	30,340	163 1	35,920	2	42,740	164 2	42,740	164 1	42,120
7	8	34,060	2	30,340	2	36,540	2	42,740	2	42,740	0	41,500
8	7	33,440	2	30,340	2	36,540	2	42,740	2	42,740	0	41,500
9	6	32,820	2	30,3 0	2	36,540	2	42,740	2	42,740	0	41,500
10	5	32,200	2	30,340	2	36,540	2	42,740	2	42,740	0	41,500
11	162 5	32,200	162 2	30,340	163 2	36,540	164 2	42,740	164 2	42,740	163 8	40,260
12	5	32,200	2	30,340	2	36,540	2	42,740	2	42,740	8	40,260
13	4	31,580	2	30,340	2	36,540	3	43,360	2	42,740	8	40,260
14	4	31,580	2	30,340	3	37,160	2	42,740	2	42,740	7	39,640
15	4	31,580	2	30,340	4	37,780	2	42,740	2	42,740	6	39,020
16	162 4	31,580	162 2	30,340	163 4	37,780	164 2	42,740	164 2	42,740	163 6	39,020
17	4	31,580	2	30,340	4	37,780	2	42,740	2	42,740	6	39,020
18	4	31,580	2	30,340	4	37,780	2	42,740	2	42,740	6	39,020
19	4	31,580	2	30,340	4	37,780	2	42,740	2	42,740	6	39,020
20	4	31,580	4	31,580	4	37,780	2	42,740	2	42,740	5	38,400
21	162 4	31,580	162 6	32,820	163 4	37,780	164 3	43,360	164 2	42,740	163 4	37,780
22	4	31,580	6	32,820	4	37,780	4	43,980	2	42,740	4	37,780
23	4	31,580	6	32,820	4	37,780	3	43,360	2	42,740	4	37,780
24	4	31,580	6	32,820	4	37,780	3	43,360	2	42,740	3	37,160
25	4	31,580	6	32,820	4	37,780	3	43,360	2	42,740	4	37,780
26	162 3	30,960	162 6	32,820	163 4	37,780	164 3	43,360	164 2	42,740	163 4	37,780
27	2	30,340	6	32,820	6	39,020	3	43,360	2	42,740	3	37,160
28	2	30,340	6	32,820	6	39,020	3	43,360	1	42,120	2	36,540
29	2	30,340	6	32,820	6	39,020	3	43,360	1	42,120	2	36,540
30	2	30,340	7	33,440	6	39,020	2	42,740	1	42,120	2	36,540
31	2	30,340	8	34,060	.....	.....	2	42,740	.....	.....	2	36,540

TABLE

Daily Gauge Height and Discharge of

Day.	January.		February.		March.		April.		May.		June.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge H'ght	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec. ft.	Feet.	Sec.-ft
1	163 2	36,540	163.8	40,260	162 7	33,440	161.8	27,860	162.0	29,100	163.5	38,400
2	.2	36,540	.9	40,880	.6	32,820	162.0	29,100	.1	29,720	.5	38,400
3	.3	37,160	.8	40,260	.6	32,820	161 9	28,480	.1	29,720	.5	38,400
4	.3	37,160	.6	39,020	.5	32,200	.8	27,860	.1	29,720	.5	38,400
5	.2	36,540	.8	40,260	.5	32,200	162.0	29,100	.1	29,720	.5	38,400
6	163 2	36,540	163.8	40,260	162.5	32,200	.0	29,100	162.2	30,340	163.5	38,400
7	.3	37,160	.8	40,260	.5	32,200	.0	29,160	.1	29,720	.5	38,400
8	.2	36,540	.8	40,260	.6	32,820	161.9	28,480	.2	30,340	.5	38,400
9	.2	36,540	.6	39,020	.7	33,440	.9	28,480	.2	30,340	.6	39,020
10	.3	37,160	.4	37,780	.7	33,440	.9	28,480	.2	30,340	.8	40,260
11	163.2	36,540	163.2	36,540	162.6	32,820	161.9	28,480	162 2	30,340	164 0	41,500
12	.2	36,540	.0	35,300	.4	31,580	.9	28,480	.3	30,960	.2	42,740
13	.2	36,540	162.8	34,060	.4	31,580	.9	28,480	4	31,580	.2	42,740
14	.2	36,540	.8	34,060	.4	31,580	.9	28,480	.4	31,580	.2	42,740
15	.2	36,540	.8	34,060	.3	30,960	.9	28,480	.4	31,580	.2	42,740
16	163 2	36,540	162.8	34,060	162.6	32,820	161.9	28,480	162.4	31,580	164.2	42,740
17	.2	36,540	.8	34,060	.4	31,580	.9	28,480	4	31,580	.2	42,740
18	.2	36,540	.8	34,060	.4	31,580	.7	27,240	.5	32,200	.2	42,740
19	.2	36,540	.8	34,060	.4	31,580	.7	27,240	.5	32,200	.2	42,740
20	.2	36,540	.8	34,060	.2	30,340	.8	27,860	.5	32,200	.3	43,360
21	163.2	36,540	162.8	34,060	162.4	31,580	161.8	27,860	162.8	34,060	164.3	43,360
22	.2	36,540	6	32,820	.4	31,580	.8	27,860	.9	34,680	.3	43,360
23	.2	36,540	8	34,060	.2	30,340	.8	27,860	163.0	35,300	.3	43,360
24	.2	36,540	163.1	35,920	.1	29,720	162.0	29,100	.0	35,300	.3	43,360
25	.1	35,920	3	37,160	.1	29,720	0	29,100	.0	35,300	.3	43,360
26	163.0	35,300	163.3	37,160	162.1	29,720	162.0	29,100	163.2	36,540	164.3	43,360
27	.0	35,300	3	37,160	1	29,720	.0	29,100	.2	36,540	.4	43,980
28	.4	37,780	.2	36,540	.1	29,720	.0	29,100	.2	36,540	.4	43,980
29	.6	39,020	.0	35,300	.0	29,100	.0	29,100	.2	36,540	.4	43,980
30	.8	40,260	.....	.....	.0	29,100	.0	29,100	.3	37,160	.4	43,980
31	.8	40,260	.....	.....	161 9	28,480	.....	.....	.4	37,780	.....	.....

SESSIONAL PAPER No. 25e

No. 13.

Winnipeg River near Otter Falls, for 1908.

Days	July.		August.		September.		October.		November.		December.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge H'ght	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet	Sec. ft.	Feet.	Sec.-ft
1	164.3	43,360	164.0	41,500	163.4	37,180	162.8	34,060	162.1	29,720	161.3	24,760
2	.4	43,980	.0	41,500	.6	39,020	.8	34,060	.0	29,100	.3	24,760
3	.4	43,980	.9	41,500	.6	39,020	.9	34,680	.1	29,720	.2	24,140
4	.4	43,980	163.9	40,880	.5	38,400	.8	34,060	.1	29,720	.2	24,140
5	.4	43,980	.8	40,260	.5	38,400	.7	33,440	.1	29,720	.2	24,140
6	164.4	43,980	163.8	40,260	163.5	38,400	162.6	32,820	162.2	30,340	161.2	24,140
7	.4	43,980	.8	40,260	.5	38,400	.7	33,440	.1	29,720	.2	24,140
8	.4	43,980	.8	40,260	.5	38,400	.7	33,440	.0	29,100	.2	24,140
9	.4	43,980	.8	40,260	.4	37,780	.7	33,440	.0	29,100	.3	24,760
10	.4	43,980	.8	40,260	.4	37,780	.7	33,440	.0	29,100	.2	24,140
11	164.3	43,360	163.8	40,260	163.3	37,160	162.7	33,440	162.0	29,100	161.2	24,140
12	.3	43,360	.8	40,260	.2	36,540	.7	33,440	.0	29,100	.2	24,140
13	.3	43,360	.8	40,260	.1	35,920	.7	33,440	.1	29,720	.2	24,140
14	.3	43,360	.8	40,260	.0	35,300	.7	33,440	.1	29,720	.2	24,140
15	.3	43,360	.7	39,640	162.9	34,680	.6	32,820	.0	29,100	.0	22,900
16	164.3	43,360	163.7	39,640	.9	34,680	162.6	32,820	162.0	29,100	161.0	22,900
17	.3	43,360	.6	39,020	.9	34,680	.8	34,060	.0	29,100	.1	23,520
18	.3	43,360	.6	39,020	.9	34,680	.7	33,440	.0	29,100	.1	23,520
19	.3	43,360	.6	39,020	.9	34,680	.7	33,440	.0	29,100	.1	23,520
20	.2	42,740	.6	39,020	.9	34,680	.7	33,440	161.8	27,860	.1	23,520
21	164.1	42,120	163.6	39,020	162.9	34,680	162.7	33,440	.8	27,860	161.0	22,900
22	.1	42,120	.6	39,020	.8	34,060	.6	32,820	.8	27,860	0	22,900
23	.1	42,120	.6	39,020	.8	34,060	.6	32,820	.7	27,240	.0	22,900
24	.1	42,120	.6	39,020	.8	34,060	.5	32,200	.7	27,240	160.9	22,280
25	.1	42,120	.6	39,020	.8	34,060	.5	32,200	.6	26,620	.9	22,280
26	164.1	42,120	163.5	38,400	162.8	34,060	162.5	32,200	161.6	26,620	160.9	22,280
27	.0	41,500	.5	38,400	.8	34,060	.5	32,200	.5	26,000	.8	21,660
28	.0	41,500	.4	37,780	.8	34,060	.5	32,200	.4	25,380	.8	21,660
29	.0	41,500	.4	37,780	.8	34,060	.4	31,580	.4	25,380	.8	21,660
30	.0	41,500	.4	37,780	.7	33,440	.4	31,580	.4	25,380	.8	21,660
31			.4	37,780			.2	30,340			.8	21,660

TABLE

Daily Gauge Height and Discharge of

Day.	January.		February.		March.		April.		May.		June.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge H'ght.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft
1	160·89	22,280	160·99	22,900	160·89	22,280	160·10	17,320	160·00	16,700	161·20	24,140
2	·89	22,280	·99	22,900	·79	21,660	·10	17,320	159·90	16,100	·20	24,140
3	·89	22,280	99	22,900	·69	21,040	·10	17,320	90	16,100	·25	24,450
4	·89	22,280	·99	22,900	·59	20,420	·00	16,700	·90	16,100	·20	24,140
5	·89	22,280	·99	22,900	·59	20,420	·00	17,700	·90	16,100	·30	24,760
6	160·89	22,280	160·99	22,900	160·49	19,800	160·10	17,320	159·90	16,100	161·30	24,760
7	·99	22,900	·19	24,140	·49	19,800	·10	17,320	160·00	16,700	·30	24,760
8	161·29	24,760	·29	24,760	·49	19,800	·00	16,700	·10	17,320	·25	24,450
9	·69	27,240	·39	25,380	·49	19,800	·00	16,700	·20	17,940	·30	24,760
10	·79	27,860	·39	25,380	·49	19,800	·00	16,700	·20	17,940	·30	24,760
11	161·69	27,240	161·39	25,380	160·49	19,800	160·00	16,700	160·30	18,560	161·25	24,450
12	·69	27,240	·49	26,000	·49	19,800	·00	16,700	·40	19,180	·30	24,760
13	·89	28,480	·59	26,620	·39	19,180	·00	16,700	·50	19,800	·30	24,760
14	·89	28,480	·59	26,620	·39	19,180	·00	16,700	·60	20,420	·30	24,760
15	·79	27,860	·59	26,620	·39	19,180	·00	16,700	·70	21,040	·25	24,450
16	161·79	27,860	·59	26,620	160·39	19,180	160·00	16,700	160·70	21,040	161·30	24,760
17	·79	27,860	·59	26,620	·29	18,560	159·90	16,100	·70	21,040	·25	24,450
18	·69	27,240	·39	25,380	·09	17,320	·90	16,100	·80	21,660	·30	24,760
19	·59	26,620	·19	24,140	·19	17,940	·90	16,100	·80	21,660	·20	24,140
20	·59	26,620	160·99	22,900	.....	17,940	·90	16,100	·80	21,660	·20	24,140
21	161·49	26,000	·89	22,280	.....	17,940	160·00	16,700	160·90	22,280	161·30	24,760
22	·09	23,520	·89	22,280	.....	17,320	159·90	16,100	·90	22,280	·25	24,450
23	.....	23,210	99	22,900	.....	17,320	160·00	16,700	161·00	22,900	·25	24,450
24	160·99	22,900	·99	22,900	160·09	17,320	·00	16,700	·00	22,900	·30	24,760
25	.....	22,900	161·09	23,520	·09	17,320	·00	16,700	·10	23,520	·30	24,760
26	.....	22,900	·09	23,520	160·09	17,320	160·00	16,700	161·10	23,520	161·30	24,760
27	.....	22,900	160·99	22,900	·09	17,320	·00	16,700	·10	23,520	·25	24,450
28	.....	22,900	9·9	22,900	·09	17,320	·00	16,700	·10	23,520	25	24,450
29	.....	22,900	.....	.....	·09	17,320	·00	16,700	·10	23,520	·30	24,760
30	.....	22,900	.....	.....	·09	17,320	·08	16,700	·20	24,140	·30	24,760
31	.....	22,900	.....	.....	159·99	16,700	.....	.....	·20	24,140	.....	.....

SESSIONAL PAPER No. 25e

No. 14.

Winnipeg River, near Otter Falls, for 1909.

Day.	July.		August.		September.		October.		November.		December.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	161·25	24,450	161·25	24,450	161·10	23,520	160·80	21,660	160·50	19,800	160·70	21,940
2	·25	24,450	·25	24,450	·00	22,900	·75	21,350	·45	19,490	·75	21,350
3	·30	24,760	·20	24,140	·00	22,900	·75	21,350	·50	19,800	·75	21,350
4	·30	24,760	·20	24,140	·00	22,900	·75	21,350	·55	20,110	·75	21,350
5	·30	27,760	·20	24,140	·05	23,210	·75	21,350	·55	20,110	·75	21,350
6	161·30	24,760	161·30	24,760	161·00	22,900	160·75	21,350	160·55	20,110	160·75	21,350
7	·35	25,070	·30	24,760	160·90	22,280	·75	21,350	·55	20,110	·75	21,350
8	·35	25,070	·30	24,760	·95	22,590	·70	21,040	·55	20,110	·80	21,660
9	·35	25,070	·30	24,760	·85	21,970	·65	20,730	·55	20,110	·85	21,970
10	·35	25,070	·30	24,760	·90	22,280	·60	20,420	·55	20,110	·95	22,590
11	161·30	24,760	161·25	24,450	160·90	22,280	160·55	20,110	160·55	20,110	160·95	22,590
12	·30	24,760	·25	24,450	·90	22,280	·55	20,110	·55	20,110	·95	22,590
13	·30	24,760	·30	24,760	·95	22,590	·50	19,800	·60	20,420	·95	22,590
14	·30	24,760	·35	25,070	·95	22,590	·50	19,800	·60	20,420	·95	22,590
15	·30	24,760	·35	25,070	·90	22,280	·50	19,800	·60	20,420	·95	22,590
16	161·30	24,760	161·35	25,070	160·90	22,280	160·50	19,800	160·60	20,420	160·95	22,590
17	·30	24,760	·30	24,760	·90	22,280	·45	19,490	·60	20,420	·95	22,590
18	·30	24,760	·30	24,760	·95	22,590	·50	19,800	·65	20,730	·95	22,590
19	·30	24,760	·30	24,760	·90	22,280	·55	20,110	·65	20,730	·95	22,590
20	·30	24,760	·20	24,140	·90	22,280	·55	20,110	·65	20,730	·95	22,590
21	161·30	24,760	161·25	24,450	160·85	21,970	160·50	19,800	160·65	20,730	160·95	22,590
22	·30	24,760	·25	24,450	·85	21,970	·55	20,110	·65	20,730	·95	22,590
23	·30	24,760	·25	24,450	·85	21,970	·55	20,110	·70	21,040	·95	22,590
24	·30	24,760	·25	24,450	·80	21,660	·55	20,110	·70	21,040	161·00	22,900
25	·25	24,450	·25	24,450	·80	21,660	·55	20,110	·70	21,040	·00	22,900
26	161·20	24,140	161·25	24,450	160·80	21,660	160·50	19,800	160·70	21,040	161·00	22,900
27	·25	24,450	·30	24,760	·80	21,660	·45	19,490	·70	21,040	·05	23,210
28	·20	24,140	·30	24,760	·80	21,660	·55	20,110	·70	21,040	·20	24,140
29	·20	24,140	·25	24,450	·80	21,660	·55	20,110	·70	21,040	·35	25,070
30	·15	23,830	·15	23,830	·80	21,660	·50	19,800	·70	21,040	·20	24,140
31	·20	24,140	·10	23,520	.....	.....	·50	19,800	.....	.....	·20	24,140

TABLE

Daily Gauge Height and Discharge of

Day.	January.		February		March		April.		May.		June.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft
1	161·20	24,140	161·30	24,760	161·20	24,140	161·40	25,380	165·50	50,880	165·70	52,160
2	·20	24,140	·30	24,760	·20	24,140	·50	26,000	·55	51,200	·65	51,840
3	·20	24,140	·36	24,760	·20	24,140	·60	26,620	·70	52,160	·60	51,520
4	·50	26,000	·30	24,760	·20	24,140	·70	27,240	·75	52,480	·55	51,200
5	·35	25,070	·30	24,760	·20	24,140	·90	28,480	·80	52,800	·60	51,520
6	161·40	25,380	161·30	24,760	161·20	24,140	162·20	30,340	165·85	53,120	165·65	51,840
7	·40	25,380	·25	24,450	·20	24,140	·40	31,580	·90	53,440	·65	51,840
8	·50	26,000	·20	24,140	·20	24,140	·60	32,820	·85	53,120	·65	51,840
9	·70	27,240	·20	24,140	·20	24,140	·80	34,060	·80	52,800	·65	51,840
10	·50	26,000	·20	24,140	·20	24,140	163·10	35,920	·80	52,800	·65	51,840
11	161·50	26,000	161·20	24,140	161·20	24,140	·30	37,160	165·80	52,800	165·60	51,520
12	·50	26,000	·20	24,140	·20	24,140	·50	38,400	·80	52,800	·50	50,880
13	·50	26,000	·20	24,140	·15	23,830	·60	39,020	·80	52,800	·45	50,560
14	·50	26,000	·20	24,140	·15	23,830	·75	39,950	·80	52,800	·35	49,920
15	·50	26,000	·20	24,140	·15	23,830	·90	40,880	·85	53,120	·25	49,280
16	161·45	25,690	161·20	24,140	161·15	23,830	164·00	41,500	165·90	53,440	165·15	48,650
17	·40	25,380	·20	24,140	·15	23,830	·15	42,430	·85	53,120	·05	48,020
18	·40	25,380	·20	24,140	·15	23,830	·40	43,980	·85	53,120	164·95	47,390
19	·35	25,070	·20	24,140	·15	23,830	·55	44,910	·85	53,120	·85	46,770
20	·35	25,070	·20	24,140	·15	23,830	·75	46,150	·85	53,120	·85	46,770
21	161·35	25,070	161·20	24,140	161·15	23,830	164·75	46,150	165·85	53,120	164·80	46,460
22	·30	24,760	·20	24,140	·15	23,830	·75	46,150	·85	53,120	·80	46,460
23	·35	25,070	·20	24,140	·15	23,830	·85	46,770	·85	53,120	·75	46,150
24	·35	25,070	·20	24,140	·15	23,830	165·00	47,760	·85	53,120	·75	46,150
25	·35	25,070	·20	24,140	·10	23,520	·20	48,960	·86	52,800	·70	45,840
26	161·30	24,760	161·20	24,140	161·05	23,210	165·25	49,280	165·80	52,800	164·65	45,530
27	·30	24,760	·20	24,140	·00	22,900	·30	49,600	·80	52,800	·55	44,910
28	·30	24,760	·20	24,140	·00	22,900	·30	49,600	·85	53,120	·50	44,600
29	·30	24,760	.....	.....	·05	23,210	·30	49,600	·85	53,120	·40	43,980
30	·30	24,760	.....	.....	·05	23,210	·40	50,240	·80	52,800	·30	43,360
31	·20	24,140	.....	.....	·20	24,140	.....	.....	·75	52,480	.....	.....

SESSIONAL PAPER No. 25e

No. 15.

Winnipeg River, near Otter Falls, for 1910.

Day.	July.		August.		September.		October.		November.		December.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge H'ght	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft
1	164·25	43,050	161·80	27,860	160·80	21,660	160·25	18,250	159·78	15,500	159·38	13,450
2	·20	42,740	·90	28,480	·80	21,660	·20	17,940	·74	15,180	·35	13,250
3	·20	42,740	·65	26,930	·70	21,040	·20	17,940	·74	15,180	·35	13,250
4	·15	42,430	·60	26,620	·70	21,040	·25	18,250	·70	14,950	·35	13,250
5	·10	42,120	·55	26,310	·70	21,040	·15	17,630	·70	14,950	·30	13,050
6	164·00	41,500	161·60	26,620	160·70	21,040	160·20	17,940	159·70	14,950	159·30	13,050
7	·00	41,500	·55	26,310	·65	20,730	·20	17,940	·70	14,950	·30	13,050
8	163·90	40,880	·50	26,000	·50	19,800	·20	17,940	·70	14,950	·30	13,050
9	·90	40,880	·45	25,690	·45	19,490	·20	17,940	·65	14,630	·30	13,050
10	·90	40,880	·50	26,000	·45	19,490	·20	17,940	·60	14,400	·30	13,050
11	163·85	40,570	161·45	25,690	160·50	19,800	160·15	17,630	159·60	14,400	159·30	13,050
12	·75	39,950	·40	25,380	·40	19,180	·15	17,630	·65	14,630	·30	13,050
13	·70	39,640	·35	25,070	·45	19,490	·05	17,010	·65	14,630	·30	13,050
14	·70	39,640	·35	25,070	·40	19,180	·00	16,700	·60	14,400	·30	13,050
15	·60	39,020	·35	25,070	·40	19,180	·00	16,700	·50	13,900	·20	12,700
16	163·55	38,710	161·35	25,070	160·40	19,180	160·05	17,010	159·44	13,680	159·20	12,700
17	·40	37,780	·40	25,380	·35	18,870	·00	16,700	·50	13,900	·20	12,700
18	·25	36,850	·15	23,830	·40	19,180	·00	16,700	·40	13,450	·20	12,700
19	·10	35,920	·30	24,760	·45	19,490	·05	17,010	·50	13,900	·20	12,700
20	·09	35,800	·00	22,900	·40	19,180	·05	17,010	·55	14,150	·25	12,880
21	165·85	34,370	161·15	23,830	160·30	18,560	160·10	17,320	159·50	13,900	159·25	12,880
22	·65	33,130	·00	22,900	·35	18,870	·00	16,700	·45	13,680	·18	12,700
23	·55	32,510	·15	23,830	·35	18,870	159·95	16,400	·40	13,450	·14	12,550
24	·50	32,200	·10	23,520	·40	19,180	·90	16,100	·50	13,900	·12	12,400
25	·50	32,200	·00	22,900	·40	19,180	·90	16,100	·50	13,900	·10	12,400
26	162·45	31,890	160·95	22,590	160·10	19,180	159·90	16,100	159·50	13,900	159·10	12,400
27	·35	31,270	·90	22,280	·40	19,180	·87	15,800	·50	13,900	·20	12,700
28	·25	30,650	·90	22,280	·30	18,560	·85	15,800	·50	13,900	·15	12,550
29	·05	29,410	·90	22,280	·35	18,870	·85	15,800	·45	13,680	·30	13,050
30	161·85	28,170	·90	22,280	·35	18,870	·82	15,500	·42	13,450	·35	13,250
31	·75	27,550	·85	21,970			·80	15,500			·40	13,450

TABLE

Daily Gauge Height and Discharge of

Day.	January.		February.		March.		April.		May.		June.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge H'ght	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft
1	159·50	13,800	159·50	13,800	159·42	13,350	159·00	12,000	159·25	12,780	160·10	16,860
2	·58	14,300	·54	14,050	·30	12,950	158·90	11,700	·30	12,950	·15	17,140
3	·66	14,550	·58	14,300	·30	12,950	159·00	12,000	·30	12,950	·20	17,420
4	·78	15,300	·46	13,580	·30	12,950	·10	12,300	·30	12,950	·20	17,420
5	·72	14,800	·55	14,050	·35	13,150	·08	12,300	·35	13,150	·20	17,420
6	159·70	14,800	159·65	14,550	159·38	13,350	159·02	12,000	159·40	13,350	160·20	17,420
7	·70	14,800	·54	14,050	·42	13,350	·02	12,000	·45	13,580	·20	17,420
8	·70	14,800	·42	13,350	·20	12,600	·02	12,600	·40	13,350	·20	17,420
9	·71	14,800	·48	13,800	·15	12,450	·02	12,000	·45	13,580	·25	17,700
10	·75	15,050	·50	13,800	·18	12,600	·00	12,000	·47	13,580	·25	17,700
11	159·80	15,300	159·48	13,800	159·00	12,000	159·00	12,000	159·48	13,800	160·30	17,980
12	·95	16,050	·40	13,350	·40	13,350	·05	12,150	·50	13,800	·35	18,260
13	160·00	16,300	·32	12,950	12	12,300	·05	12,150	·50	13,800	·35	18,260
14	·05	16,580	·23	12,780	·18	12,600	·05	12,150	·60	14,300	35	18,260
15	·10	16,860	·23	12,780	·14	12,450	·12	12,300	·70	14,800	·35	18,260
16	160·15	17,140	159·23	12,780	159·14	12,450	159·15	12,450	159·77	15,050	160·35	18,260
17	·00	16,300	·23	12,780	·14	12,450	·15	12,450	·79	15,300	·38	18,540
18	159·78	15,300	·25	12,780	·12	12,300	·17	12,450	·85	15,550	·36	18,260
19	·76	15,050	·28	12,950	·10	12,300	·17	12,450	·87	15,550	·40	18,540
20	·72	14,800	·30	12,950	·08	12,300	·17	12,450	·90	15,800	·40	18,540
21	159·68	14,800	159·30	12,950	159·05	12,150	159·25	12,780	159·90	15,800	160·39	18,540
22	·64	14,550	27	12,780	·10	12,300	·25	12,780	·88	15,800	·43	18,826
23	·62	14,300	·25	12,780	·12	12,300	·25	12,780	·90	15,800	46	18,820
24	·60	14,300	·22	12,600	·15	12,450	·25	12,780	·90	15,800	·50	19,100
25	·60	13,800	·22	12,600	·13	12,450	·25	12,780	·90	15,800	·58	19,660
26	159·40	13,350	159·25	12,780	159·00	12,000	159·27	12,780	159·95	16,050	160·60	19,630
27	·40	13,350	·30	12,950	158·90	11,700	·32	12,950	·98	16,300	·60	19,660
28	·40	13,350	·35	13,150	159·10	12,300	·31	12,950	160·02	16,300	·60	19,660
29	·45	13,580	.....	.....	·07	12,150	·30	12,950	·05	16,580	·62	19,660
30	·45	13,580	.....	.....	·15	12,450	·25	12,780	·10	16,860	·62	19,660
31	·50	13,800	.....	.....	·05	12,150	.....	.....	·10	16,860	.....	.....

SESSIONAL PAPER No. 25e

No. 16.

Winnipeg River, near Slave Falls, for 1911.

Day.	July.		August.		September.		October.		November.		December.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge H'ght	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft
1	160·62	19,660	161·62	25,260	161·68	25,820	161·47	24,420	161·60	25,260	160·75	20,500
2	·62	19,660	·61	25,260	·65	25,540	·50	24,700	·57	24,980	·72	20,220
3	·64	19,940	·60	25,260	·62	25,260	·50	24,700	·55	24,980	·68	20,220
4	·66	19,940	·63	25,540	·65	25,540	·56	24,980	·50	24,700	·65	19,940
5	·66	19,940	·65	25,540	·65	25,540	·64	25,540	·45	24,420	·65	19,940
6	160·66	19,940	161·68	25,820	161·64	25,540	161·75	26,100	161·42	24,140	160·62	19,660
7	·66	19,940	·72	25,820	·60	25,260	·79	26,380	·37	23,860	·60	19,660
8	·78	20,780	·78	26,380	·55	24,980	·85	26,660	·36	23,860	·60	19,660
9	·90	21,340	·84	26,660	·48	24,700	·85	26,660	·34	23,860	·56	19,380
10	·90	21,340	·90	26,940	·45	24,420	·85	26,660	·33	23,860	·56	19,380
11	160·95	21,620	161·87	26,660	161·46	24,420	161·90	26,940	161·33	23,860	160·60	19,660
12	161·05	22,180	·85	26,660	·40	24,140	·93	27,220	·30	23,580	·60	19,660
13	·10	22,460	·85	26,660	·38	24,140	·80	26,380	·25	23,300	·60	19,660
14	·15	22,740	·85	26,660	·40	24,140	·80	26,380	·20	23,020	·55	19,380
15	·18	23,020	·85	26,660	·43	24,420	·80	26,380	·15	22,740	·55	19,380
16	161·25	23,300	161·83	26,660	161·43	24,420	161·80	26,380	161·15	22,740	160·56	19,380
17	·34	23,860	·81	26,380	·45	24,420	·65	25,540	·10	22,460	·66	19,940
18	·42	24,140	·81	26,380	·47	24,420	·70	25,820	·10	22,460	·55	19,380
19	·48	24,700	·80	26,380	·50	24,700	·75	26,100	·10	22,460	·54	19,380
20	·48	24,700	·78	26,380	·53	24,980	·75	26,100	·05	22,180	·53	19,380
21	161·52	24,700	161·77	26,100	161·56	24,980	161·78	26,380	161·05	22,180	160·52	19,100
22	·52	24,700	·75	26,100	·57	24,980	·80	26,380	·05	22,180	·50	19,100
23	·52	24,700	·76	26,100	·57	24,980	·75	26,100	·00	21,900	·50	19,100
24	·52	24,700	·76	26,100	·54	24,980	·75	26,100	161·00	21,900	·48	19,100
25	·52	24,700	·75	26,100	·51	24,700	·70	25,820	160·95	21,620	·50	19,100
26	161·55	24,980	161·75	26,100	161·48	24,700	161·70	25,820	·90	21,340	160·46	18,820
27	·60	25,260	·73	26,100	·45	24,420	·70	25,820	·90	21,340	·42	18,540
28	·62	25,260	·70	25,820	·48	24,700	·70	25,820	·88	21,340	·40	18,540
29	·62	25,260	·70	25,820	·45	24,420	·68	25,820	·85	21,060	·35	18,260
30	·62	25,260	·68	25,820	·48	24,700	·65	25,540	·80	20,780	·30	17,980
31	·62	25,260	·68	25,820	...	...	·60	25,260	...	...	·30	17,980

TABLE

Daily Gauge Height and Discharge of

Day.	January.		February.		March.		April.		May.		June.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge H'ght	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft
1	160.30	17,980	160.40	18,540	159.85	15,550	.....	12,700	.....	16,500	162.05	22,780
2	.30	17,980	.40	18,540	.84	15,550	.....	12,700	160.07	16,580	.15	28,340
3	.30	17,980	.35	18,260	.83	15,550	.....	12,700	.10	16,860	.15	28,340
4	.35	18,260	.30	17,980	.82	15,300	159.23	12,775	.45	18,820	.....	29,000
5	.40	18,540	.28	17,980	.80	15,300	23	12,775	.50	19,100	.	29,700
6	160.65	19,940	160.28	17,980	159.77	15,050	.....	12,800	160.40	18,540	162.50	30,300
7	161 00	21,900	.28	17,980	.75	15,050	.....	12,800	.48	19,100	50	30,300
8	.05	22,180	.25	17,700	.72	14,800	.....	12,900	.52	19,100	.55	30,580
9	.10	22,460	.23	17,700	.68	14,800	.....	12,900	.65	19,940	.30	29,180
10	.10	22,460	.20	17,420	.66	14,550	.....	12,900	.....	20,500	.25	28,900
11	161.10	22,460	160.15	17,140	159.64	14,550	.....	12,900	160.85	21,060	...	28,700
12	.10	22,460	.12	16,860	.62	14,300	159.29	12,950	.....	21,500	.....	28,400
13	.05	22,180	.10	16,860	.....	14,300	.....	13,000	161.00	21,900	.....	28,200
14	.05	22,180	.05	16,580	.....	14,000	.....	13,000	.20	23,020	....	28,000
15	.00	21,900	.02	16,300	.....	14,000	.....	13,000	.35	23,860	162.05	27,780
16	160.95	21,620	160.00	16,300	.....	13,700	.....	13,100	.....	24,000	162 05	27,780
17	.70	20,220	.00	16,300	.....	13,700	.....	13,100	161.40	24,140	.03	27,780
18	.70	20,220	.00	16,300	.....	13,400	.....	13,100	.43	24,420	.15	28,340
19	.70	20,220	159.98	16,300	.....	13,400	159.35	13,150	.....	24,600	.01	27,500
20	.65	19,940	.97	16,050	.....	13,100	.....	13,200	161.50	24,700	.03	27,780
21	160 66	19,660	159.96	16,050	.....	13,100	.....	13,500	161.51	24,700	162.03	27,780
22	.55	19,380	.95	16,050	159.30	12,950	.....	13,800	.55	24,980	.00	27,500
23	.55	19,380	.94	16,050	.....	12,700	.....	14,100	.62	25,260	161.95	27,220
24	.55	19,380	.93	16,050	.....	12,500	.....	14,400	.70	25,820	.90	26,940
25	.50	19,100	.92	15,800	159.12	12,300	.....	14,700	.74	26,100	.80	26,380
26	169.45	18,820	159.91	15,800	.....	12,400	.....	15,000	.....	26,400	161.89	26,940
27	.45	18,820	.89	15,800	.....	12,400	.....	15,300	161.85	26,660	.88	26,940
28	.45	18,820	.89	15,800	.....	12,500	.....	15,600	.88	26,940	....	26,940
29	.43	18,820	.88	15,800	.....	12,500	.....	15,900	.91	26,940	.89	26,940
30	.41	18,540	.....	.....	.....	12,600	.....	16,200	.95	27,220	.87	26,660
31	.40	18,540	.....	.....	.....	12,600	.....	.....	.98	27,500	.....	.....

SESSIONAL PAPER No. 25e

No. 17.

Winnipeg River, at Slave Falls, for 1912.

Day.	July.		August.		September.		October.		November.		December.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height	Discharge.	Gauge Height.	Discharge.	Gauge Height	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec. ft.	Feet.	Sec. ft
1	161.96	27,220	162.05	27,780	161.99	27,500	.....	30,300	163.25	34,500	162.60	30,860
2	.89	26,940	.05	27,780	.99	27,500	.....	30,500	.25	34,500	.60	30,860
3	.87	26,660	.01	27,500	162.00	27,500	.	30,700	.25	34,500	.60	30,860
4	.84	26,660	.05	27,780	.47	30,020	.....	31,900	.25	34,500	.60	30,860
5	.79	26,380	.09	28,060	.35	29,460	.....	31,100	.20	34,220	.60	30,860
6	161.75	26,100	162.07	27,780	162.16	28,340	.....	31,300	163.15	33,940	162.60	30,860
7	.76	26,100	.10	28,060	.25	28,900	162.70	31,420	.15	33,940	.50	30,300
8	.78	26,380	.05	27,780	.25	28,900	.70	31,420	.15	33,940	.50	30,300
9	.76	26,100	.05	27,780	.26	28,900	.74	31,700	.15	33,940	.50	30,300
10	.76	26,100	.06	27,780	.25	28,900	.80	31,980	.15	33,940	.50	30,300
11	161.75	26,100	162.07	27,780	162.23	28,960	162.91	32,540	163.15	33,940	162.40	29,740
12	.76	26,100	.08	28,060	.25	28,900	.96	32,820	.10	33,660	.40	29,740
13	.76	26,100	.04	28,060	.25	28,900	.98	33,100	.10	33,660	.40	29,740
14	.75	26,100	.03	27,780	.....	29,000	163.03	33,380	.00	33,100	.30	29,180
15	.77	26,100	.03	27,780	..	29,200	.05	33,380	162.90	32,540	.30	29,180
16	161.79	26,380	162.03	27,780	...	29,300	163.06	33,380	.85	32,260	162.30	29,180
17	.80	26,380	.02	27,500	.	29,500	.10	33,660	.85	32,260	.20	28,620
18	.78	26,380	.04	27,780	.....	29,600	.10	33,660	.85	32,260	.20	28,620
19	.75	26,100	.05	27,780	.....	29,800	.15	33,940	.85	32,260	.20	28,620
20	.76	26,100	161.98	27,500	.....	29,900	.20	34,220	.85	32,260	.20	28,620
21	161.74	26,100	162.00	27,500	162.45	30,020	163.28	34,780	162.80	31,980	162.20	28,620
22	.70	25,820	.05	27,780	.46	30,020	.28	34,780	.80	31,980	.20	28,620
23	.75	26,100	.03	27,780	.48	38,300	.28	34,780	.80	31,980	.20	28,620
24	.77	26,100	161.98	27,500	.51	30,300	.25	34,500	.80	31,980	.20	28,620
25	.79	26,380	162.00	27,500	.58	30,860	.25	34,500	.75	31,700	.20	28,620
26	161.80	26,380	.00	27,500	162.57	30,500	163.20	34,220	162.75	31,700	162.20	28,620
27	.84	26,660	.00	27,500	.56	30,580	.20	34,220	.75	31,700	.20	28,620
28	.85	26,660	.00	27,500	.56	30,580	.20	34,220	.75	31,700	.20	28,620
29	.89	26,940	161.99	27,500	.46	30,020	.25	34,500	.75	31,700	.20	28,620
30	.90	26,940	162.00	27,500	.....	30,100	.25	24,500	.75	31,700	.10	28,060
31	.94	27,220	.00	27,500	..	...	.30	34,780	.....	...	10	28,060

TABLE

Daily Gauge Height and Discharge of

Day.	January.		February.		March.		April.		May.		June.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge H'ght	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft
1	162·1	28,060	162·1	28,060	160·9	21,340	159·9	15,800	160·89	21,340	162·81	31,980
2	·0	27,500	·1	28,060	·9	21,340	·95	16,050	161·11	22,460	·94	32,820
3	·0	27,500	·1	28,060	·9	21,340	·95	16,050	·18	23,020	·89	32,540
4	·0	27,500	·1	28,060	·8	20,780	160·0	16,300	·27	23,300	·96	32,820
5	·0	27,500	·1	28,060	·8	20,780	·0	16,300	·51	24,700	163·00	33,100
6	162·0	27,500	162·1	28,060	160·8	20,780	160·0	16,300	161·61	25,260	162·93	32,820
7	·0	27,500	·1	28,060	·8	20,780	·0	16,300	·72	25,820	·96	32,820
8	·0	27,500	0	27,500	·7	20,220	·0	16,300	·70	25,820	·92	32,540
9	·0	27,500	·0	27,500	·7	20,220	·0	16,300	·82	26,380	163·03	33,380
10	·0	27,500	·0	27,500	·6	19,660	·0	16,300	·89	26,940	·02	33,100
11	162·0	27,500	162·0	27,500	160·6	19,660	160·05	16,586	161·98	27,500	163·05	33,380
12	·1	28,060	0	27,500	·5	19,100	·05	16,580	162·03	27,780	·05	33,380
13	·1	28,060	·0	27,500	·5	19,100	·05	16,580	·03	27,780	·11	33,660
14	·1	28,060	·0	27,500	·5	19,100	·05	16,580	·10	28,060	·05	33,380
15	·1	28,060	161·9	26,940	·4	18,540	·05	16,580	·11	28,060	162·94	32,820
16	162·1	28,060	·9	26,940	160·4	18,540	160·1	16,860	162·14	28,340	163·01	33,100
17	·1	28·060	·8	26,380	·4	18,540	·1	16,860	·12	28,060	·02	33,100
18	·1	28,060	·8	26,380	·3	17,980	·15	17,140	·15	28,340	162·99	33,100
19	·1	28,060	·6	25,260	·3	17,980	·15	17,140	·37	29,460	·94	32,820
20	·1	28,060	·6	25,260	·3	17,980	·2	17,420	·43	30,020	·90	32,540
21	162·1	28,060	161·3	23,580	160·2	17,420	160·2	17,420	162·43	30,020	162·88	32,540
22	·1	28,060	·3	23,580	·2	17,420	·3	17,980	·43	30,020	·87	32,260
23	·1	28,060	·2	23,020	·1	16,860	·3	17,980	·68	31,420	·95	32,820
24	·1	28,060	·1	22,460	·1	16,860	·4	18,540	·70	31,420	·96	32,820
25	·1	28,060	·1	22,460	·1	16,860	·5	19,100	·78	31,980	·85	32,260
26	162·1	28,060	161·0	21,900	160·1	16,860	160·5	19,100	162·80	31,980	162·86	32,260
27	·1	28,060	·0	21,900	·1	16,860	·6	19,660	·76	31,700	·85	32,260
28	·1	28,060	·0	21,900	·1	16,860	·7	20,220	·88	32,540	·92	32,540
29	·1	28,060	.....	.....	·0	16,300	·7	20,220	·86	32,260	·85	32,260
30	·1	28,060	.....	.....	0	16,300	·7	20,220	·83	32,260	·91	32,540
31	·1	28,060	.....	.....	159·9	15,800	.....	.....	·86	32,260	.....	.....

No. 18.

Winnipeg River, near Slave Falls, for 1913.

Day.	July.		August.		September.		October.		November.		December.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge H'ght	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft
1	162·89	32,540	161·90	26,940	161·84	26,660	161·03	22,180	159·80	15,300	159·89	15,800
2	·93	32,820	·90	26,940	·80	26,380	160·93	21,620	·60	14,300	·82	15,300
3	·91	32,540	·87	26,660	·81	26,380	·75	20,500	·70	14,800	·82	15,300
4	·91	32,540	162·00	27,500	·80	26,380	·59	19,660	·70	14,800	·77	15,050
5	·82	31,980	161·94	27,220	·77	26,100	·62	19,660	·91	15,800	·79	15,300
6	162·75	31,700	·98	27,500	161·70	25,820	160·70	20,220	159·87	15,550	159·77	15,050
7	·81	31,980	160·02	27,500	·60	25,260	·42	18,540	·84	15,550	·54	14,050
8	·72	31,420	·01	27,500	·77	26,100	·45	18,820	·84	15,550	·82	15,300
9	·71	31,420	·02	27,500	·76	26,100	·46	18,820	·84	15,550	·76	15,050
10	·73	31,700	161·97	27,220	·70	25,820	·45	18,820	..	15,550	·79	15,300
11	162·80	31,980	162·07	27,780	161·62	25,260	160·32	17,980	.....	15,500	159·74	15,050
12	·68	31,420	·09	28,060	·66	25,540	·16	17,140	.....	15,450	·69	14,800
13	·52	30,300	·12	28,060	·62	25,260	·32	17,980	.....	15,450	·72	14,800
14	·52	30,300	·07	27,780	·54	24,980	·27	17,700	.....	15,450	·56	14,050
15	·51	30,300	·16	28,340	·61	25,260	·19	17,420	.....	15,350	·59	14,300
16	162·37	29,460	162·13	28,340	161·59	25,260	160·19	17,420	159·79	15,300	159·59	14,300
17	·24	28,900	·09	28,060	·58	25,260	·16	17,140	.....	15,250	·64	14,550
18	·11	28,060	·20	28,620	·63	25,540	·06	16,580	.....	15,200	·56	14,050
19	·37	27,780	·19	28,620	·48	24,700	159·65	14,550	.....	15,150	·56	14,050
20	161·99	27,500	·14	28,340	·43	24,420	160·02	16,300	.....	15,150	·46	13,800
21	·98	27,500	162·06	27,780	161·36	23,860	160·07	16,580	.....	15,050	159·49	13,800
22	162·00	27,500	·05	27,780	·58	25,260	·02	16,300	.....	15,000	·46	13,570
23	161·94	27,220	161·98	27,500	·53	24,980	·02	16,300	159·69	14,800	·49	13,800
24	·90	26,940	·96	27,220	·48	24,700	·00	16,300	.....	15,000	·59	14,300
25	·93	27,220	·95	27,220	·40	24,140	159·78	15,300	.....	15,100	·44	13,570
26	161·82	26,380	161·92	26,940	161·35	23,860	159·99	16,300	.....	15,300	159·39	13,350
27	·72	25,820	·92	26,940	·25	23,300	160·60	19,660	159·84	15,550	·32	12,950
28	·85	26,660	·88	26,940	16	22,740	·10	16,860	86	15,550	·38	13,350
29	·89	26,940	·85	26,660	·24	23,300	·10	16,860	82	15,360	·51	13,800
30	·88	26,940	·85	26,660	13	22,740	160·00	16,300	·64	14,550	·54	14,050
31	·89	26,940	·78	26,380	.....	.....	·00	16,300	.....	.....	·51	13,800

TABLE No. 19.

Monthly Discharge of Winnipeg River at Otter Falls, for 1907.

(Drainage area, 53,000 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.
January	28,170	26,000	26,960	·509	·17
February	29,100	18,560	22,880	·432	45
March	19,180	15,500	17,320	·327	·38
April	16,700	14,400	14,590	275	·31
May	20,420	14,400	16,290	·307	·35
June	33,440	21,660	28,030	·529	·59
July	34,060	30,340	32,020	·604	·70
August	34,060	30,340	31,340	591	·68
September	39,020	34,680	37,140	·701	·78
October	43,980	39,020	42,520	·802	·92
November	42,740	42,120	42,680	·805	·90
December	42,740	36,540	39,500	·745	·88
The year	43,980	14,460	29,460	·556	7 09

Note.—These discharges were obtained by using the gauge heights recorded at the municipal power plant, city of Winnipeg, Pointe du Bois, Man., together with the discharge measurements taken by Pratt and Ross for the Street Railway Co., at Otter falls.

Gauge readings were commenced at Pointe du Bois on January 23, 1907, and hence, the discharge given for January, 1907, applies only for nine days, and the year period is for 343 days.

TABLE No. 20.

Monthly Discharge of Winnipeg River at Otter Falls, for 1908.

(Drainage area, 53,000 square miles)

Month.	Discharge in Second-Feet.				Run-off.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.
January	40,260	35,300	36,880	696	·80
February	40,880	32,820	36,650	·692	·75
March	33,440	28,480	31,380	·592	·68
April	29,100	27,240	28,500	·538	·60
May	37,780	29,100	32,600	·615	71
June	45,980	38,400	41,640	·786	88
July	43,980	41,500	42,980	811	·94
August	41,500	37,780	39,560	·747	86
September	39,020	33,440	35,900	677	76
October	34,680	30,340	33,040	·623	72
November	30,340	25,380	28,400	536	·60
December	24,760	21,660	23,340	·440	·51
The year	43,980	21,660	34,230	646	8 81

Note. These discharges were obtained by using the gauge heights recorded at the municipal power plant, city of Winnipeg, Pointe du Bois, Manitoba, together with the discharge measurements taken by Pratt and Ross for the Street Railway Co. at Otter falls.

TABLE No. 21.

Monthly Discharge of Winnipeg River at Otter Falls, for 1909.

(Drainage area, 53,000 square miles.)

Month	Discharge in Second Feet			Run Off.	
	Maximum	Minimum.	Mean	Per square mile.	Depth in inches on drainage area.
January	28,480	23,280	24,770	·467	·54
February	26,620	22,280	24,180	·456	·48
March	22,280	16,700	18,820	·355	·41
April	17,320	16,100	16,700	·315	·35
May	24,140	16,100	20,360	·383	·44
June	24,760	24,140	24,560	·463	·52
July	25,070	23,830	24,650	·465	·54
August	25,070	23,520	24,530	·463	·53
September	23,520	21,660	22,290	·420	·47
October	21,660	19,490	20,330	·384	·44
November	21,040	19,490	20,470	·386	·43
December	25,070	21,040	22,530	·425	·49
The year	28,480	16,100	22,010	·415	5·64

Note—These discharges were obtained by using the gauge heights recorded at the municipal power plant city of Winnipeg, Pointe du Bois, Man., together with the discharge measurements taken by Pratt and Ross, for the Street Railway Co. at Otter falls.

TABLE No. 22.

Monthly Discharge of Winnipeg River at Otter Falls for 1910.

(Drainage area, 53,000 square miles.)

Month.	Discharge in Second-Feet.			Run-Off.	
	Maximum.	Minimum	Mean.	Per square mile.	Depth in inches on Drainage Area.
January	27,240	24,140	25,260	·477	·55
February	24,760	24,140	24,280	·458	·48
March	24,140	22,900	23,830	·450	·52
April	50,240	25,380	39,900	·753	·84
May	53,440	50,880	52,820	·997	1·15
June	52,160	43,360	48,690	·919	1·03
July	43,050	27,550	36,950	·697	·80
August	28,480	21,970	24,700	·466	·54
September	21,660	18,560	19,630	·370	·41
October	18,250	15,500	17,600	·321	·37
November	15,500	13,450	14,280	·270	·30
December	13,450	12,400	12,920	·244	·28
The year	53,440	12,400	28,360	·535	7·27

Note—These discharges were obtained by using the gauge heights recorded at the municipal power plant, city of Winnipeg, Pointe du Bois, Man., together with the discharge measurements taken by Pratt and Ross, for the Street Railway Co. at Otter falls.

TABLE No. 23.

Monthly Discharge of Winnipeg River, at Slave falls for 1911.

(Drainage area, 52,000 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on Drainage area.
January	17,140	13,350	14,820	·285	·33
February	14,550	12,600	13,280	·255	·27
March	13,350	11,700	12,540	·241	·28
April	12,950	11,700	12,390	·238	·27
May	16,860	12,780	14,770	·284	·33
June	19,660	16,860	18,340	·353	·39
July	25,260	19,660	22,900	·440	·51
August	26,940	25,260	26,130	·503	·58
September	25,820	24,140	24,810	·477	·53
October	27,220	24,420	25,960	·499	·57
November	25,260	20,780	22,950	·441	·49
December	20,500	17,980	19,330	·372	·43
The year	27,220	11,700	19,060	·36	4·98

Note.—These discharges were obtained by using the gauge heights recorded at the municipal power plant, Pointe du Bois, together with the discharge measurements taken by the Manitoba Hydrographic Survey at Slave falls.

TABLE No. 24.

Monthly Discharge of Winnipeg River, at Slave Falls, for 1912.

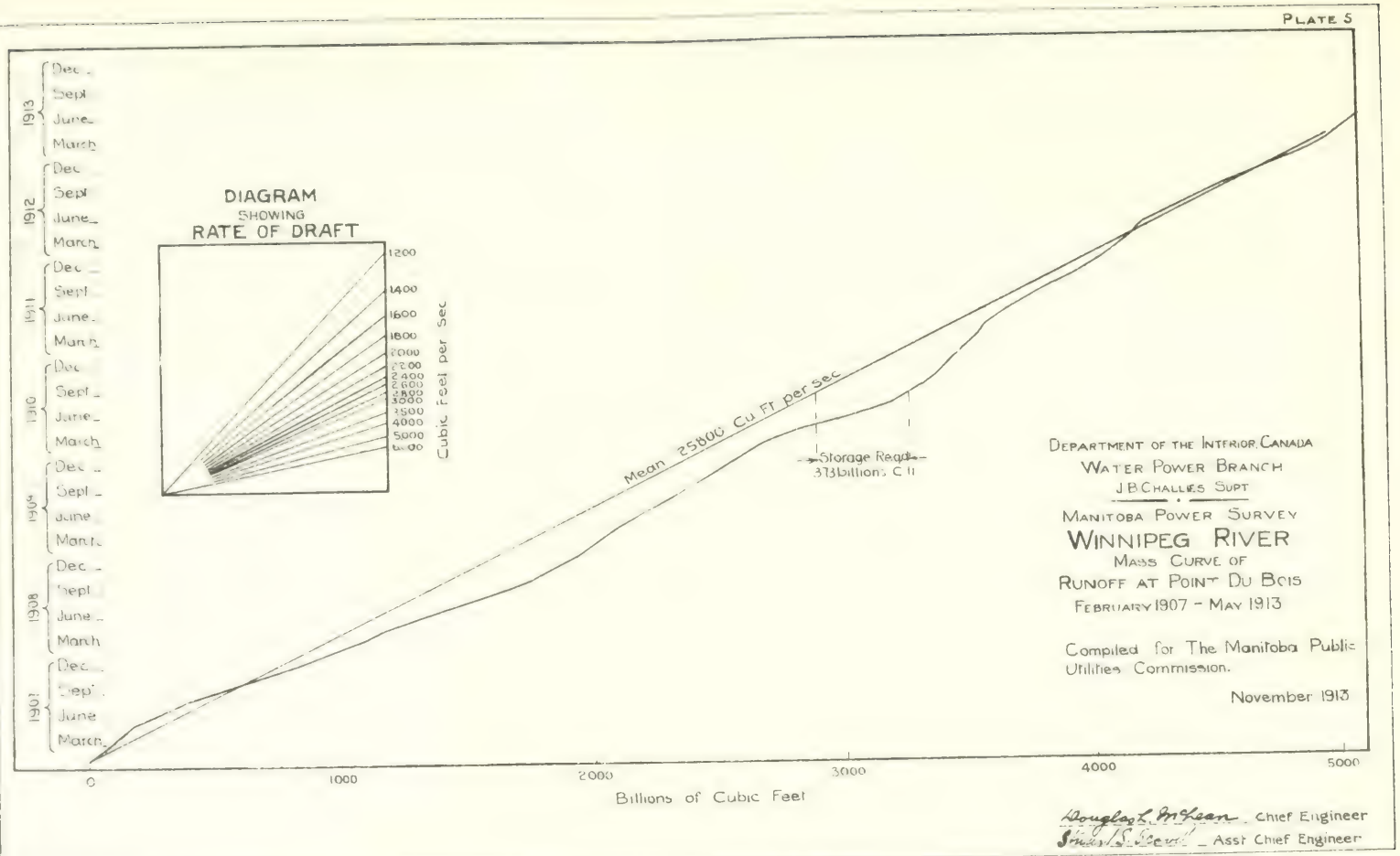
(Discharge area, 52,000 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on Drainage area.
January	22,460	17,980	20,080	·386	·445
February	18,540	15,800	16,840	·324	·350
March	15,550	12,300	13,820	·266	·307
April	16,200	12,700	13,570	·261	·291
May	27,500	16,500	22,800	·439	·506
June	30,580	26,380	28,100	·540	·602
July	27,220	25,820	26,380	·507	·585
August	28,060	27,500	27,710	·533	·617
September	30,860	27,500	29,410	·566	·631
October	34,780	30,300	33,070	·636	·735
November	34,500	31,700	32,610	·627	·700
December	30,860	28,060	29,400	·565	·652
The year	34,780	12,300	24,510	·471	6·446

Note.—These discharges were obtained by using the gauge heights recorded at the municipal power plant, Pointe du Bois, together with the discharge measurements taken by the Manitoba Hydrographic Survey at Slave falls.

For the year 1912, stop logs were in place in the Norman Dam at the western outlet of the Lake of the Woods until October 4, 1912, when twenty stop logs were removed. On October 17, 1912, ten more logs were removed. These thirty logs remained out throughout the balance of the year. The Head-race Mill 'A,' Keewatin, was closed from June 22nd. to November 22nd., 1912.

PLATE 5



DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
J.B. CHALLIES SUPT

MANITOBA POWER SURVEY

WINNIPEG RIVER

MASS CURVE OF
RUNOFF AT POINT DU BOIS
FEBRUARY 1907 – MAY 1913

Compiled for The Manitoba Public Utilities Commission.

November 1913

Douglas L. McLean, Chief Engineer
Fred S. Scott, Asst Chief Engineer

5.—Existing Power Plants.

(a) *Winnipeg Electric Railway Co.*

The Winnipeg Electric Railway Company's development is situated some sixty miles from Winnipeg on the Pinawa or Lee channel. This channel is an old high-water channel of some 25 miles in length, which has been improved and is being further enlarged. The water for the plant is turned into the Pinawa channel by three diversion dams, the main of which consists of 1,332 feet of concrete-capped rock-fill across the main channel, connected with the banks on either side by concrete spillways, bringing the total length to 1,650 feet. Two small weirs of timber crib type span secondary channels. The water thus diverted flows down the improved channels to a control dam which is capable of shutting off the flow and returning a portion or all of it to the main river over the waste or diversion weir. From the control dam the water flows through the tortuous bed of the old high-water channel, the same having been deepened and partially straightened by excavation. This waterway, while at present capable of carrying in summer some 10,000 second-feet, is only able in winter, on account of the ice, to deliver about two-thirds of this amount. Below the power-house the tail-race has been improved by dredging and excavation. The power-house is situated at a bend in the river, where a concrete dam with arched spillway creates a thirty-nine foot head. The headworks are equipped with débris boom, ice-run, spillway, trash-racks and head gates. The electrical units of this plant consist of: Four 1,000 k.w. and five 2,000 k.w. revolving field, 60 cycle, 2,300 volt, three phase generators, together with two 125 k.w. direct current exciters. The generators are capable of carrying a 50 per cent overload, giving in all a total output of 21,000 k.w. or 28,200 horse-power. When 21,000 k.w. are available at this plant for peak loads, an additional 9,000 can be obtained from an auxiliary steam turbine station at Winnipeg, operated by the company. The electric energy is transmitted to the city of Winnipeg at 60,000 volts over a 65-mile transmission line.

(b) *City of Winnipeg Municipal Plant.*

The municipal power development of the city of Winnipeg is situated some seventy-seven miles northeast from Winnipeg at Pointe du Bois on the Winnipeg river. This plant consists essentially of a large concrete power station, with retaining walls and spillways forming the forebay, the entrance to which is controlled by a stoplog sluiceway type of headgate. Two concrete weirs or spill dams control the elevation of the head-waters, and, together with a rock-fill dam, divert the water to the forebay for use at the power-house.

This power concentration has created a head varying from 44 to 48 feet, with a pondage of seven square miles above the plant. This pondage is a great asset during periods of peak loads.

The development is designed for an ultimate installation of 16 units, each consisting of two-runner high speed turbines rated at 5,200 horse-power for 46 feet head, and a 3-phase 3,000 kilowatt generator. The final installation would give 48,000 kilowatts, with turbines of a maximum capacity of 83,200 horse-power. As each turbine unit requires 1,250 second-feet under maximum output at a net head of 45 feet and running at 164 revolutions per minute, the total water required would be 20,000 second-feet, plus the water for the two small exciter units.

The present installation consists of five generators of 3,000 kilowatts each and two exciters of 250 kilowatts each, making a total of 15,500 kilowatts, and at a maximum load requires 7,800 second-feet.

The electric energy is transmitted to the city of Winnipeg at 66,000 volts over a 77-mile transmission line, built on a municipally-owned 100-foot right of way. The conductors are of aluminum, supported on steel towers throughout. A duplicate line is now under consideration.

6.—Basis of Discussion on Government Power Proposals.

The cost estimates for the Government power proposals on the Winnipeg river refer in all cases to the capital cost of installation, and are based on both initial and final development. The initial development is designed to utilize at each site the present minimum flow of the river, *i.e.*, 12,000 second-feet, or such portion of it as may be available at the particular site in question. The final development is designed to utilize at each site, a regulated flow of 20,000 second-feet, or such portion of it as may be available at the site. After the diversion of sufficient water into the Pinawa channel to properly operate the plant of the Winnipeg Electric Railway Company, there would remain for use at Seven Sisters, in the main river, about 4,000 and 12,000 second-feet under unregulated and regulated conditions of the river, respectively. It is important to note that it is on this basis that the available power of the Seven Sisters sites is discussed.

In order that the power sites could be compared on a rational and equitable basis, all the layouts and designs have been standardized in so far as possible, giving full consideration to the varying heads, and to the local physical conditions at each individual site. No allowance has been made in the estimate for transmission, the costs being in all cases the capital cost for power on the low tension switchboard in the power-house, and the power being considered as straight 24-hour power at 75 per cent efficiency, based on the flow. This forms a very conservative basis. Transmission costs are omitted from the estimates, as it is impossible to foretell the use to which the power at the various sites may be applied when developed, and a straight comparison of the sites as they stand is desired. The costs given herewith may be slightly altered upon final revision.

In all cases the dams are designed in solid concrete, with ample discharging capacity to pass the severest floods to be anticipated. The power stations have been developed on single runner vertical turbine installations, varied for the different heads and to meet local conditions.

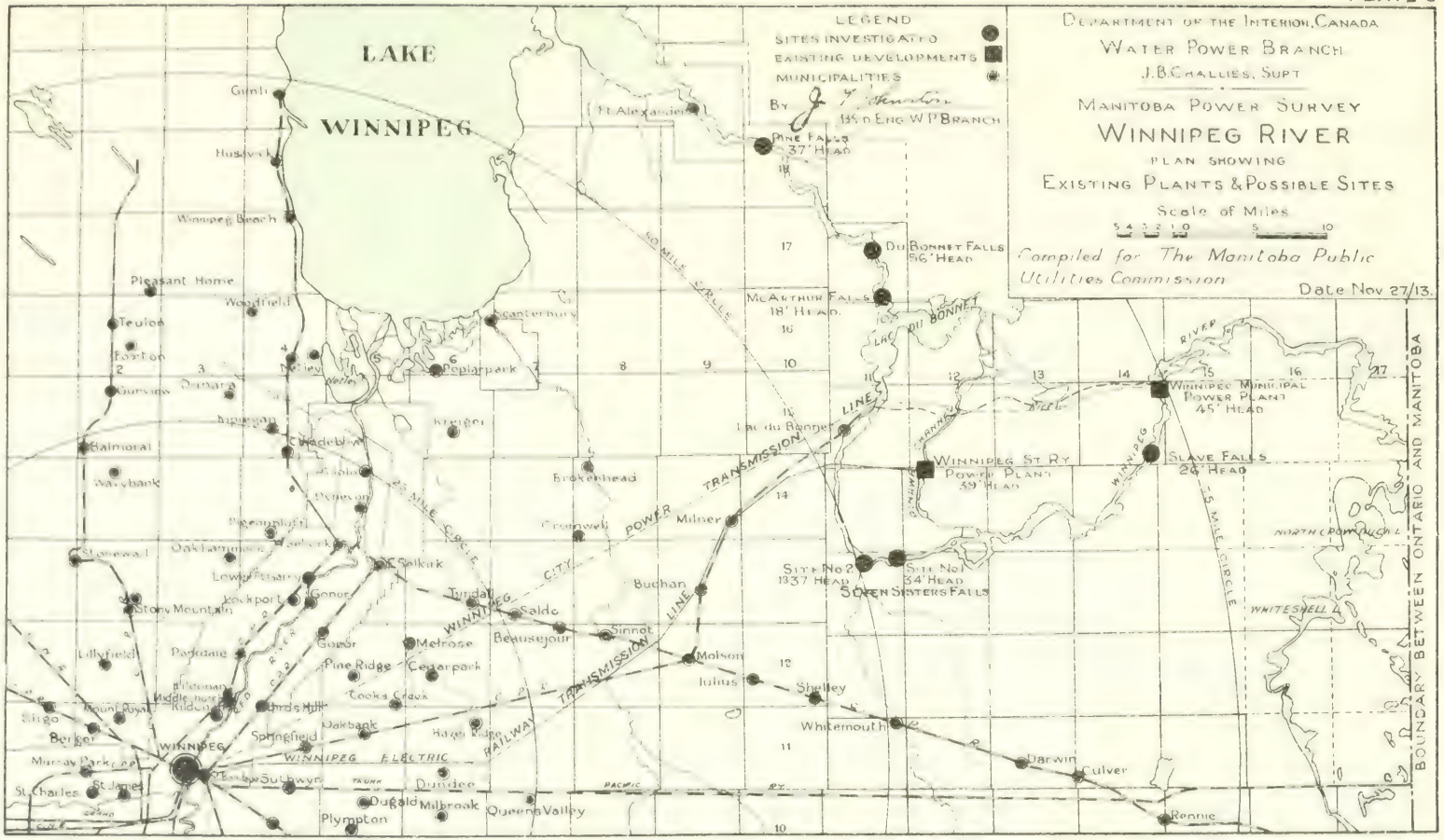
A continuous profile of the river to sea-level datum was run at the beginning of the field work, and forms the groundwork upon which the whole survey was developed. Recognition of the future needs of navigation has been given, and provision in the permanent work for the accommodation, if necessary, of future lockage facilities at the different sites has been made.

7.—Government Power Proposals.

(*a*) *Slave Falls Site.*

The proposed development at Slave falls concentrates a head of 26 feet, formed by the combination of the Slave and Eight-Foot falls. The dam runs along the crest of the falls and, curving downstream through an arc of about 90 degrees, connects with the power station on the right bank of the river. Provision has been made for the future installation of a lock on the left bank.

The head and tail-water elevation, as at present proposed, are 928 and 902 respectively. The initial installation on which the estimate is made provides for eight 5,000 horse-power turbines sufficient to provide for a flow of 12,000 second-feet at $\frac{8}{10}$ gate, with a spare machine for emergencies. On a 75 per cent efficiency, 24-hour basis, 26,600 horse-power will be available at a capital cost of $93.45 per horse-power at the low tension switchboard. The final installation provides thirteen 5,000 horse-power turbines, sufficient for a flow of 20,000 second-feet at $\frac{8}{10}$ gate, with a spare machine. On a 75 per cent efficiency, 24-hour basis, 44,400 horse-power will be available at a cost of $83.30 per horse-power at the switchboard.


LAKE
WINNIPEG
LEGEND
SITES INVESTIGATED
EXISTING DEVELOPMENTS
MUNICIPALITIES
By J. T. Thwaites
1st Eng. W.P. Branch
DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
J.B. CHALLIES, SUPT
MANITOBA POWER SURVEY
WINNIPEG RIVER
PLAN SHOWING
EXISTING PLANTS & POSSIBLE SITES
Scale of Miles
Compiled for The Manitoba Public Utilities Commission
Date Nov 27/13.
BOUNDARY BETWEEN ONTARIO AND MANITOBA
Gimli
Husavick
Winnipeg Beach
Pleasant Home
Woodfield
Teulon
Gunview
Balmoral
Warrybank
Stonewall
Stony Mountain
Lockport
Selkirk
Oakhammock
Lilyfield
Pardale
Sturgeon Creek
Middle Ridge
Sharpe Hill
Sago
Berker
Mount Royal
Springfield
Oakbank
Pine Ridge
Cedarpark
Cooks Creek
Gonor
Metrose
Benusejour
Saldo
Turdall
Brokenhead
Crosswell
Milner
Buchan
Sinnet
Molson
Julius
Shelley
Whitemouth
Darwin
Culver
Rennie
Dundee
Dugald
Milbrook
Queens Valley
Plympton
St Charles
St James
Murray Park
Elmwood
Transcona
Poplarpark
Canterbury
Kreiger
Lac du Bonnet
Pine Falls
37' Head
Du Bonnet Falls
56' Head
McArthur Falls
18' Head
Site No 2
133' Head
Site No 1
54' Head
Seven Sisters Falls
Winnipeg St Ry
Power Plant
39' Head
Slave Falls
24' Head
Winnipeg Municipal
Power Plant
45' Head
50 MILE CIRCLE
25 MILE CIRCLE
WINNIPEG CITY TRANSMISSION LINE
WINNIPEG ELECTRIC RAILWAY TRANSMISSION LINE
WINNIPEG RIVER POWER CANAL
LAC DU BONNET RIVER
WHITESHELL R.
NORTH CROMPTON L.
WINNIPEG ELECTRIC
CANADIAN PACIFIC RY.

DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
J. B. CHALLIES. SUPT.

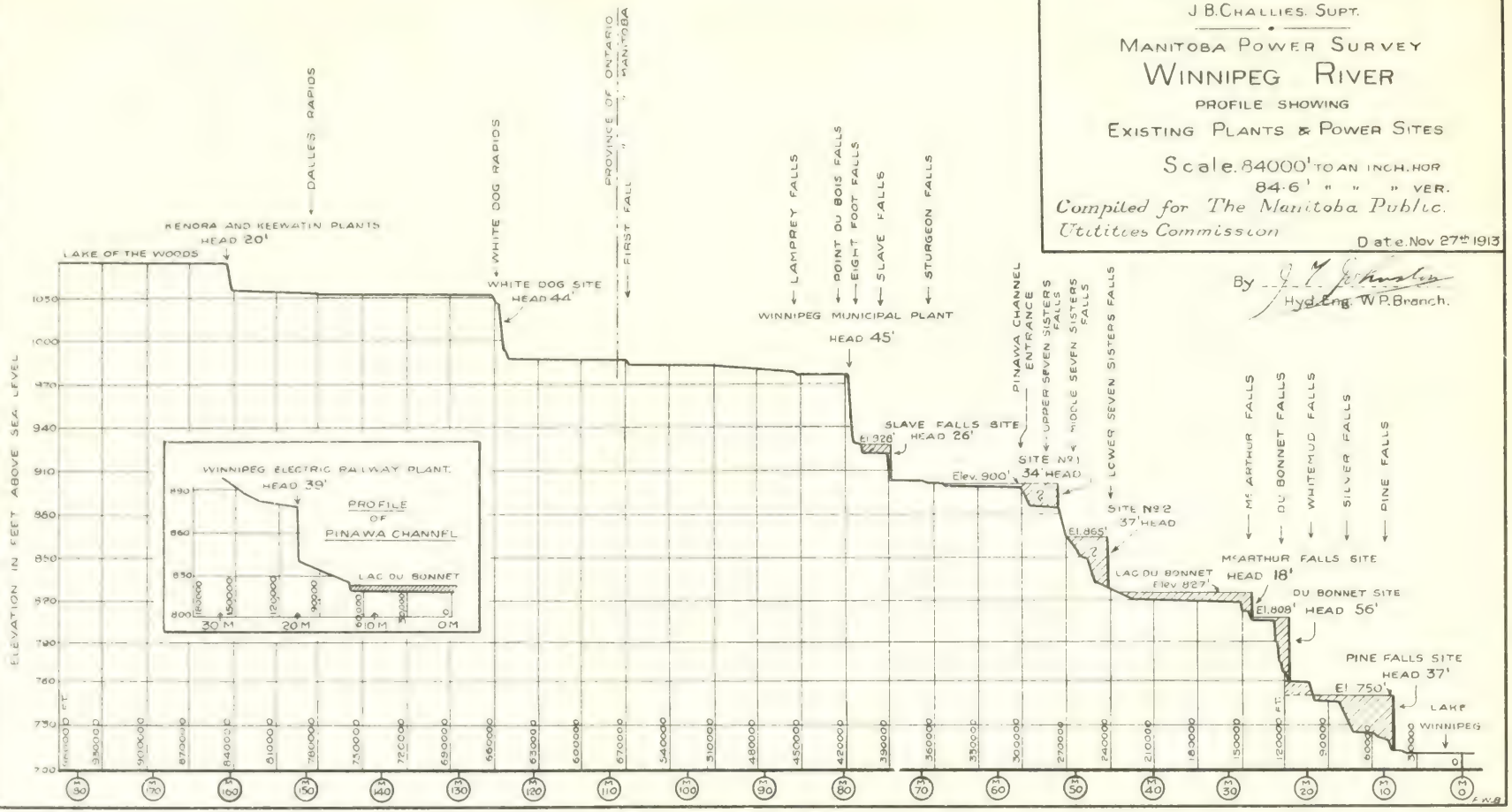
MANITOBA POWER SURVEY
WINNIPEG RIVER
PROFILE SHOWING
EXISTING PLANTS & POWER SITES

Scale. 84000' TO AN INCH. HOR
84·6' " " " VER.

Compiled for The Manitoba Public Utilities Commission

Date. Nov 27th 1913

By J. T. Thwaites
Hyd. Eng. W.P. Branch.



(b) Seven Sisters Sites.

No detail work has as yet been possible covering the best method of development of this reach of the river. However, it is considered that it can ultimately be developed at two sites of about 34 and 37 feet head, respectively. After providing sufficient water for the plant of the Winnipeg Electric Railway Company on the Pinawa channel, it is doubtful whether any development of the Seven Sisters falls will be feasible until the flow of the river can be regulated to at least 20,000 second-feet, by means of storage in the upper waters. The power available at the 34-foot site, under unregulated conditions, is about 11,600 horse-power and, under regulated conditions, 34,800 horse-power. Similarly, the 37-foot site will render available 12,600 horse-power and 30,700 horse-power respectively.

(c) McArthur Site.

At the lower of the two McArthur falls, a head of 18 feet awaits development. The river is here divided into two channels by a large island. The general layout consists of a solid concrete spillway along the crest of the fall on the right or main channel, and a long spillway and embankment, including sluiceway provision, running diagonally across the island, and connecting with the power station spanning the left channel. Provision is made on the island for the future construction of a lock.

The head-water elevation is at present fixed at 827, *i.e.*, about the highest recorded water level of Lac du Bonnet. The tail-water is proposed at 809, giving a head of 18 feet.

The initial installation provides for eleven 2,500 horse-power turbines, sufficient to provide for 12,000 second-feet at 9/10 gate, with a spare machine for emergency. On a 75 per cent efficiency, 24-hour basis, 18,400 horse-power will be available at a capital cost of $123 per horse-power at the low tension switchboard. The final installation provides for seventeen 2,500 horse-power units on a basis of a 20,000 second-feet flow and 75 per cent efficiency, 24-hour power, *i.e.*, of 30,700 horse-power. The cost per horse-power on the switchboard is $97.50. This site can be given a much more favourable aspect, when the local storage available in Lac du Bonnet (whose 32 square miles form the head-waters) is taken into consideration.

(d) Du Bonnet Site.

The proposed scheme of development at the Du Bonnet falls will ultimately concentrate there a head of 56 feet, made up of the Grand and Little du Bonnet falls, and the Whitemud falls. The latter will be added by blasting out the rock bridge over which the present fall takes place. The dam, consisting of embankment, spillway and sluiceway sections, leaves the left bank and crosses the river on the brink of the Little du Bonnet falls, connecting with the power station which parallels the right shore line below the pitch. Ice sluices and embankment connect the power station with the high land on the right bank. Provision is made for future lockage facilities on this bank.

The head-water elevation has been fixed at 808, with the tail-water at 762 previous to the blasting out of the Whitemud falls, and 752 subsequent thereto. This secures a head of 46 feet for the preliminary, and 56 feet for the final installation.

The initial installation is figured on seven 10,000 horse-power turbine units, utilizing 12,000 second-feet at 9/10 gate and 46-foot head. This on the same basis as set out above, will render available 47,100 horse-power at a capital cost of $79.40 per horse-power at the low tension switchboard. An intermediate installation, comprising 12 units and providing capacity for 20,000 second-feet at 46-foot head, and producing 78,700 horse-power has also been estimated. The cost of the power at the switchboard for this intermediate installation is $68.90 per horse-power. The final installation consists of

fourteen 10,000 horse-power units, for the development of 20,000 second feet at 56-foot head, the extra 10 feet being secured by the removal of the Whitemud falls. On the same basis as set out above, 95,500 24-hour horse-power will be available at a cost of $70.70 per horse-power on the switchboard.

(e) *Pine Falls Site.*

The Pine falls development will concentrate the natural drop of the Pine and Silver falls, giving a head of 37 feet. The dam runs diagonally across the river from the right bank, and joins directly to the power station, which forms a continuation of the dam. The power station is connected with the high ground on the left bank, by sluices and embankment. Provision is made for lockage facilities on this bank.

The head and tail-water elevations have been placed at 750 and 713 respectively. As the tail-water is practically lake Winnipeg level, it will vary from year to year with the level of the lake. The installation in the power station has not been finally determined, but the following estimates of the capital cost of the power are considered to be fairly close. The initial installation will provide for the development of 12,000 second-feet at 37-foot head, *i.e.*, 37,900 horse-power on the 75 per cent efficiency, 24-hour basis, at a cost of $80.30 per horse-power on the switchboard. The final installation provides for 20,000 second-feet, and renders available, on the above basis, 63,100 horse-power at a cost of $70.70 per horse-power on the switchboard.

8.—Summary of the Power Possibilities of the Winnipeg River.

Plate No. 8 is a tabulation of the powers, developed and undeveloped, of the Winnipeg river, under regulated and unregulated conditions. The undeveloped power is considered on a 75 per cent efficiency, 24-hour basis, and the capital cost per horse-power is given in terms of this power, estimated to the low tension switchboard in the power house.

Attention is called to the circular diagrams on plates No. 9 and No. 10 as illustrating, in a graphical manner, the developed and undeveloped power conditions along the river, under unregulated and regulated river flow.

PLATE No. 8.

Table of Developed and Undeveloped Power on the Winnipeg River.

Plant or Site.	Head water Elevation.	Tail water Elevation.	Head.	Turbine Capacity at full gate at Govt. proposals		H.P. at 75 per cent. on a 24 Hr. basis.		H.P. Developed.	Capital Cost per H.P. on Switchboard.		Remarks.
				12000 sec. ft.	20000 sec. ft.	12000 sec. ft.	20000 sec. ft.		12000 sec.-ft.	20000 sec. ft.	
									$ cts.	$ cts.	
Winnipeg Municipal Plant	975·7	939·7	45			46,100	76,800	20,800			
Slave Falls Site	928	902	26	40,000	65,000	26,600	44,400		93 45	83 30	
Winnipeg Electric Railway Co. Plant	879·4	840·4	39					28,200			Located on Pinawa channel.
First Site, Seven Sisters			34			11,600	34,800				Less discharge down Pinawa channel.
Second Site, Seven Sisters			37			12,600	37,900				" " "
McArthur Site	827	809	18	27,500	42,500	18,400	30,700		123 00	97 50	
		762	46	70,000	120,000	47,100	78,700		79 40	68 90	Preliminary head.
Du Bonnet Site	808	752	56		140,000	57,300	95,500			70 70	Final head.
Pine Site	750	713	37	55,000	95,000	37,900	63,100		80 30	70 70	

Total power with unregulated river (12,000 second feet min. flow) 238,700 horse-power.
Total power with regulated river (20,000 second feet reg. flow) 411,400 horse-power.
Total power developed to date 49,000 horse-power.

Ottawa, Ont., Dec. 12, 1913.

9.—Future Economic Value of the Winnipeg River Powers.

With regard to the future economic value of the powers of the Winnipeg river, one could not do better than quote from a report made to the Department of the Interior in September, 1911, by Mr. J. R. Freeman, one of the consulting engineers retained by the department for advice in connection with water-power matters. Mr. Freeman says:—

'*Economy and Conservation.*—While water-power opportunities on the Winnipeg river may have a very few years ago appeared so far beyond possible use that ordinary economics were unnecessary, it is, I believe, plain to-day beyond serious question that all of the remaining opportunities for power should be carefully conserved and only developed under such conditions as will not necessitate any great waste or the impairment of remaining opportunities.

'Sundry remarkable electro-chemical processes have been very recently invented, which promise to be of great future benefit to agriculture and other arts. Fertilizer for farmers' use is now being successfully made by electricity from the nitrogen of the air, and great water-powers in Norway are now being developed for these purposes in addition to those already in use, and recent developments have also been made of similar processes not far from the southern boundary of Canada.

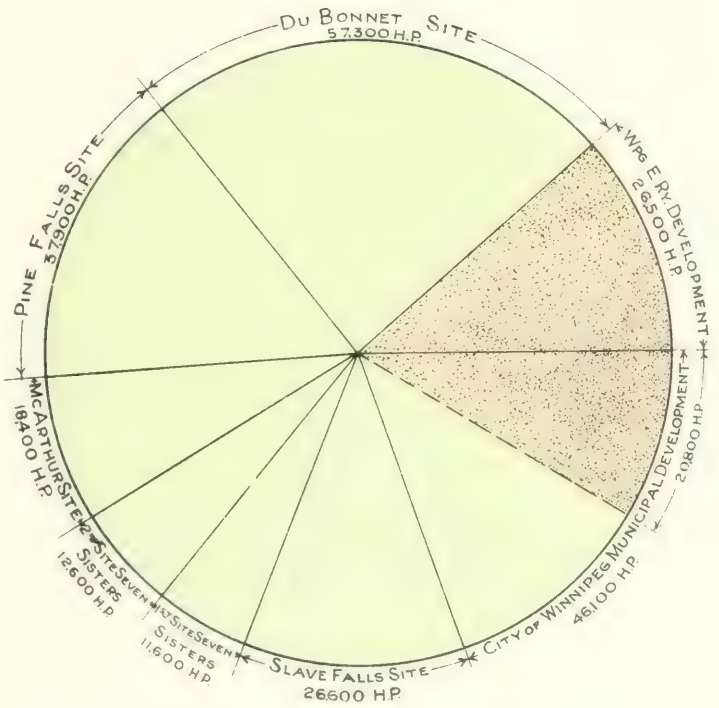
'The great uses of hydro-electric power at Niagara falls and at the Sault, for making aluminum, carbide for gas lighting, bleaching powders, and caustic soda and sundry other important products, were unknown only a few years ago. Indeed, it may be said that every one of the electro-chemical processes now located at Niagara falls has been invented since the first of the large hydro-electric power stations was built at that point. It is idle to say that the era of important electro-chemical invention is yet more than begun and, with the many able investigators now earnestly working on these lines in many parts of the world, great additional discoveries and commercial developments in the application of cheap electric power are almost sure to come, particularly in metallurgy, or the reduction of ores.

'*The Winnipeg Market now Fully Supplied.*—The city of Winnipeg will soon have all the power that it needs for public service corporation and for any conceivable manufacturing purposes likely to locate in or near the city for perhaps a score of years to come, from the railway company's plant already in use and to-day understood to be delivering about 22,000 horse-power and from the new municipal hydro-electric power plant at Pointe du Bois, now nearing completion, with a first installation of 26,000 horse-power, and with works planned to be extended to more than three times that capacity.

'Thus these two plants will be capable of delivering to Winnipeg more than 100,000 horse-power of 24-hour electrical energy, a quantity which can be best appreciated by a statement that it is far greater than the total water-power at Lowell, Lawrence, Manchester and Holyoke combined.

'*A possible Field for Use.*—The best use that I can foresee for the vast water-powers now remaining untouched upon the Winnipeg river is as the basis for founding three or four new industrial cities based upon electro-chemical industry, very much as water-power was the basis for creating, years ago, the cities of Lowell, Lawrence, Manchester, Holyoke, Bellowa Falls, and as, in recent years, it has brought together hundreds of new homes at Niagara Falls, Shawinigan Falls and at the Sault.

'We cannot to-day say what the line of manufacture may be, for the electro-chemical arts are still in a state of ferment and creation. It has



LEGEND DEVELOPED POWER

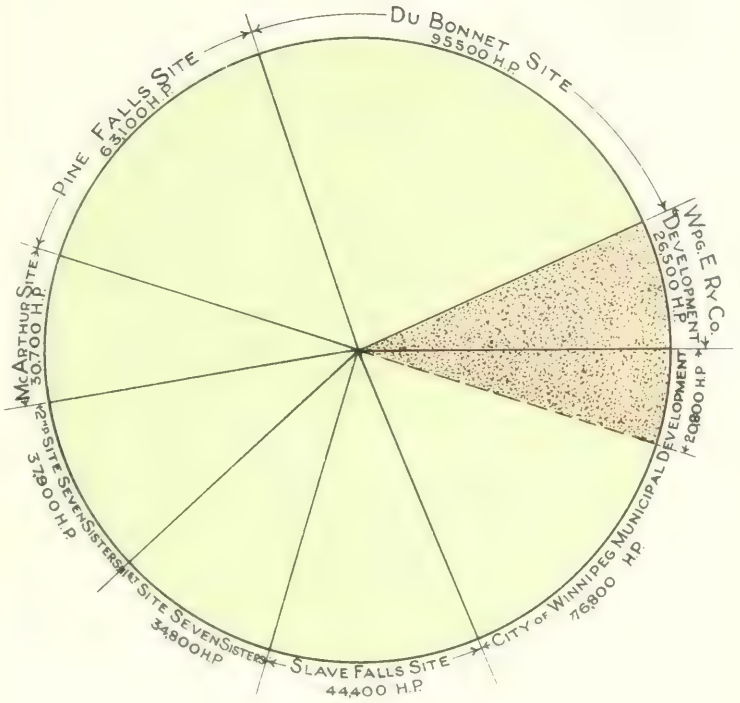
UNDEVELOPED POWER

TOTAL POWER CAPACITY OF WINNIPEG RIVER WITHOUT REGULATED FLOW	237,000 H.P.
AMOUNT DEVELOPED TO DATE	47,300 H.P.

DIAGRAM
SHOWING
THE DEVELOPED AND UNDEVELOPED POWERS
AT THE VARIOUS SITES
ON THE
WINNIPEG RIVER

NOTE Based on the unregulated flow of 12000 Sec Ft with undeveloped sites considered at 75% eff. with 24 hr power.

Dec 11th 1913



LEGEND: DEVELOPED POWER

UNDEVELOPED POWER

TOTAL POWER CAPACITY OF WINNIPEG RIVER WITH REGULATED FLOW 409,700 H.P

AMOUNT DEVELOPED TO DATE 47,300 H.P

DIAGRAM

SHOWING

THE DEVELOPED AND UNDEVELOPED POWERS

AT THE VARIOUS SITES

ON THE

WINNIPEG RIVER

NOTE: Based on a regulated flow of 20,000 Sec Ft with undeveloped sites considered at 75% eff with 24 hr power.

Dec 11th 1913.

already been demonstrated that by electric smelting, steel for the manufacture of tools can be made having a quality and value difficult to obtain otherwise. Fertilizer, in the form of artificial saltpetre, is being produced commercially in large quantities under German processes, while carbide, carborundum, aluminum and numerous other useful products are being made by electro-chemical means in great quantity at Niagara and elsewhere, and sooner or later the time will come when fertilizers will not be scorned by the farmers of the Canadian Northwest. There is promise of new metallurgical processes for which electricity is a necessity, and the price per pound of several of these products is such that they could stand a considerable cost of freighting to their markets, and such that a power capable of being developed in so vast quantity at one point and at so low a cost per horse-power as appears practicable at three of the sites along the Winnipeg river, will surely be very attractive.'

'*These New Industries must Locate Close to the Water Fall.*—These electro-chemical processes, when carried on in the large commercial way, demand that the work be done close to the point where the power is generated, for two reasons: First, because although the air-saltpetre process uses alternating current, most electro-chemical processes require the direct current at low voltage which cannot be transmitted to great distances with anything like the facility of alternating current; and second, because, in order to attract these processes, it is necessary that the cost per horse-power be the very lowest and not overloaded by the cost of long transmission lines or the percentage of power necessarily lost in such transmission.

'Wherever a new industrial centre, with some hundreds of homes, can be established in the wilderness within a hundred miles of Winnipeg, it will add to Winnipeg's prosperity in a degree but little less than if located within its borders, and will add to the prosperity of the province by the new opportunities that it brings for employment, the diversity that it adds to its business interests and by the money that it will put into circulation. It is plain that many of the recent power developments made in various parts of America, from which the power is transmitted long distances to displace steam power in populous centres, results in putting a much larger number of men out of work than it sets at work. Such a development is of less benefit to the country than the early water-power developments which are used locally in creating the cities already named, in building hundreds of new homes and in setting thousands of men working at new opportunities.'

Aug. 31st 1911
Winnipeg River, Little du Bonnet Falls

Sept. 30 1913
Winnipeg River Point-du-Bois Municipal Power Plant.
Spillway from foot of Log slide.

25th Aug 1913

C. 659
Pinawa Channel - Control Dam taken from point halfway between Dam and initial point.

Main Weir.
Street Railway Power

C.101

Silver Falls.

Sept 7th 1912
J. 340
Winnipeg River - 2nd Mc

Sept. 6th 1913
Winnipeg River. Seven Sisters - 1st Fall.

Sept 6th 1913
Winnipeg River. Seven Sisters - 2nd Fall.

WATER-POWERS OF MANITOBA

CHAPTER IV

RIVERS IN SOUTHERN PORTION OF MANITOBA

CHAPTER IV.

RIVERS IN SOUTHERN PORTION OF MANITOBA.

Whitemouth River.

A.—LOCATION.

The Whitemouth river, see plate No. 11, has its source in Whitemouth lake, which is located in the southeasterly part of the province of Manitoba. The general direction of the river is northeasterly from its source to the point where it joins the Winnipeg river, just below the Seven Sisters rapids.

B.—RIVER BASIN.

The drainage area of the river is 1,566 square miles. The lower section of this area is narrow and mostly broken up in farm lands, while the upper section spreads out and is part of what is known as the Julius muskeg.

C.—BED AND BANKS.

The bed of the river consists almost entirely of boulder clay, with occasional outcrops of rock in the lower reaches, crossing the river at right angles. These rock outcrops do not appear above bed elevation except in the vicinity of Whitemouth falls at the mouth of the river. The banks throughout, with the above exception, are composed of a sandy clay, and rise to a height of approximately 50 feet. In some localities this height is reached by a quick slope from the water's edge, while in others the slope is more gradual, running back for a distance of 400 feet.

D.—TIMBER AND VEGETATION.

For a distance of about two miles from the mouth of the river there is a large amount of valuable standing timber, including oak, spruce and poplar, but as its course is followed southward it is found that the land has been cleared off, partly by fire and partly by the efforts of the settlers in breaking up the land for farming purposes, so that only occasional clumps of poplar, ash and elm are encountered. Throughout the upper reaches of the river the land is mostly covered with small tamarack, spruce and scrub.

E.—RUN-OFF.

(*a*) *Rainfall.*—From the meteorological reports at Oakbank, to the west of the drainage basin, and at Kenora to the east, extending over a period of 22 and 9 years, respectively, it is found that the mean annual precipitation for the section of the country covered by the drainage area is approximately 21 inches.

(*b*) *Discharge Measurements.*—A metering station was established on the river at the town of Whitemouth, by the Manitoba Hydrographic Survey, in May of the year 1912. During the years of 1912-13, there have been twelve discharge measurements made at this station, the results of which are shown in table No. 25.

Daily gauge height records have also been kept at this point, and these, with their assumed daily discharges, are tabulated in tables No. 26 and No. 27.

F.—POWER SURVEY.

A reconnaissance survey of the river from the mouth up to the C.P.R. crossing at the town of Whitemouth was made by the Manitoba Hydrographic Survey in June of the present year.

G.—POWER POSSIBILITIES.

The reconnaissance profile on plate No. 11A of the power survey, shows the difference in elevation from the mouth of the river to the town of Whitemouth to be 44 feet, or 2·6 feet per mile.

Site No. 1.—Part of this drop could be concentrated at the falls at the mouth of the river, and a head of 20 feet obtained.

Site No. 2.—About three miles below the town of Whitemouth a head of approximately 20 feet is obtainable, the high banks lending themselves to successful development without flooding any considerable area of valuable land.

H.—WATER-POWER.

Based on the estimates of flow for the year ending October 31, 1913, the following table gives the power available per foot head at an 80 per cent efficiency, and is computed on a low flow of 25 second-feet, and also for the lowest monthly mean flow (100 second-feet) for a period of six months from May to October. In this latter case the estimated power only relates to the period as above stated:—

Head in Feet.	Estimated Horse-power at 80 per cent Efficiency.	
	Minimum flow 25 sec.-ft.	Flow 100 sec.-ft. Period May to October.
1	2·3	9·0
10	23	90
20	46	180

TABLE No. 25.

Discharge Measurements of Whitemouth River at Whitemouth, 1912-13.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.
1912.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-Ft.
May 29	G. H. Burnham	1187	162	990·5	2·20	4·86	2,179
June 20		1187	151	629·4	1·07	2·48	673
July 13		1187	158	749·9	1·41	3·08	1,057
July 15		1187	158·5	858·4	1·67	3·70	1,433
Aug. 9	W. G. Worden	1187	149·7	699·6	1·30	2·95	910
Sept. 3		1187	149·7	885·0	1·50	3·72	1,328
Oct. 15	R. H. Nelson	1187	172·9	936·8	2·02	4·48	1,892
1913.							
Jan. 24	A. Pr—	1469	110·0	188·6	0·145	1·22	*27
Apr. 18		1186	154·9	752·0	1·65	3·29	1,241
May 9	C. E—	1186	154·0	732·1	1·38	2·92	1,010
Aug. 15	W. J. Ireland	1469	145·0	578·0	0·68	1·95	392
Sept. 21	C. O. Allen	1435	136·0	512·2	0·30	1·44	153

* Instrument [illegible].

PLATE II

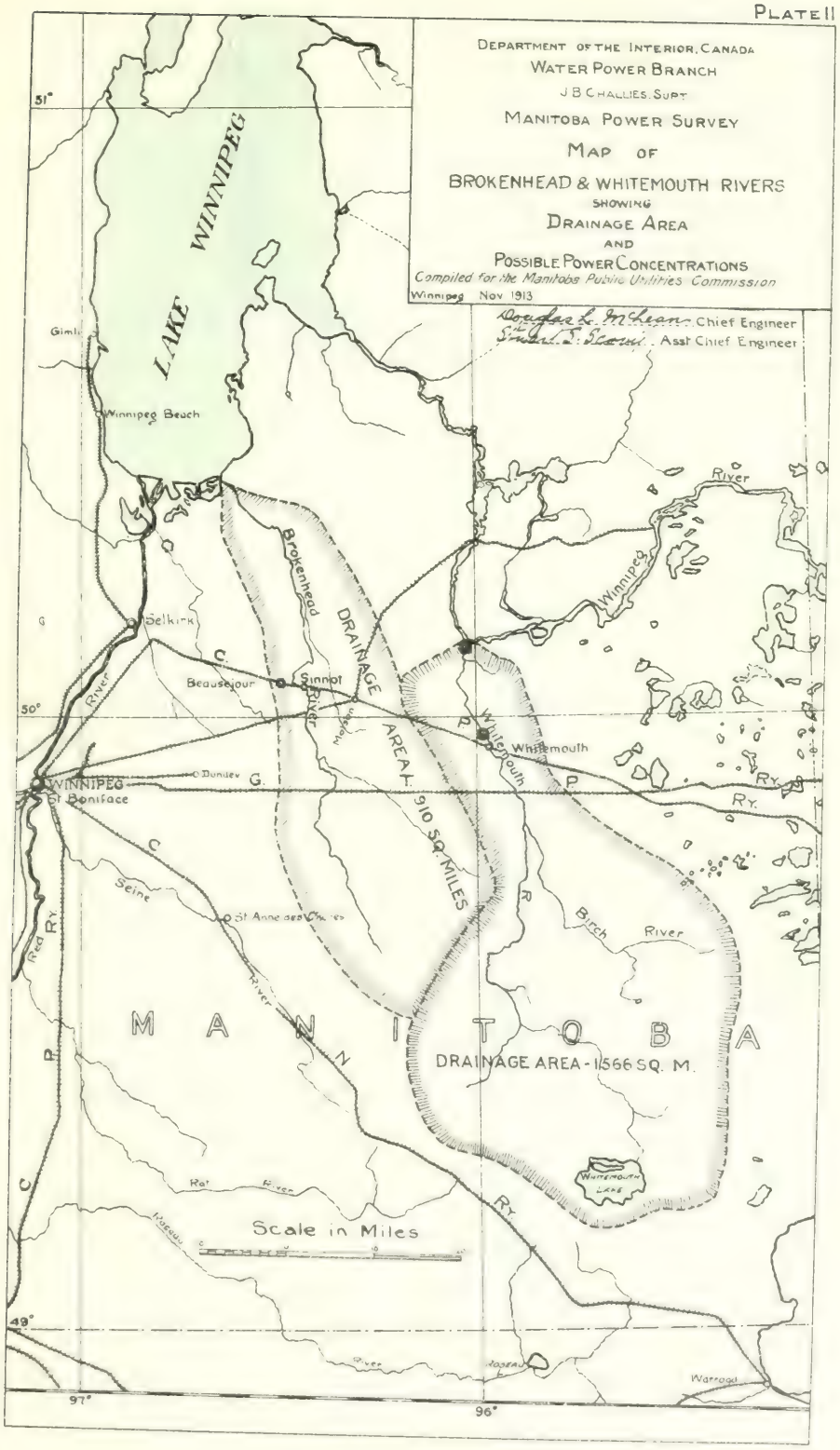
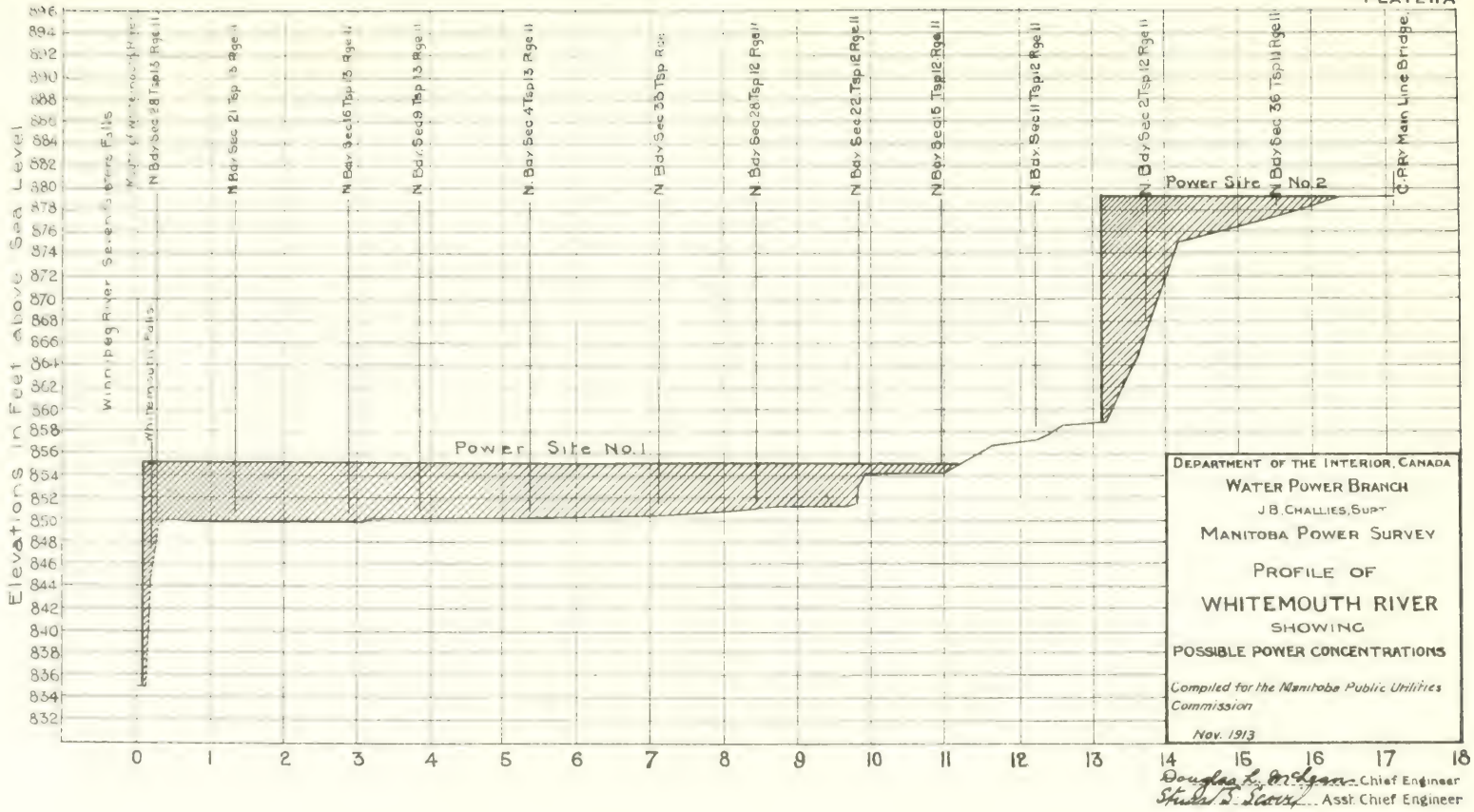

DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
J B CHALLIES, SUPT
MANITOBA POWER SURVEY
MAP OF
BROKENHEAD & WHITEMOUTH RIVERS
SHOWING
DRAINAGE AREA
AND
POSSIBLE POWER CONCENTRATIONS
Compiled for the Manitoba Public Utilities Commission
Winnipeg Nov 1913
Douglas L. McLean, Chief Engineer
Sinclair F. Scott, Asst Chief Engineer
LAKE WINNIPEG
Gimli
Winnipeg Beach
Selkirk
Brokenhead River
DRAINAGE AREA 910 SQ. MILES
Beausejour
Sinnot
Whitemouth
WINNIPEG
St Boniface
Dunlev
St Anne des Chenes
Seine River
Red River
Birch River
MANITOBA
DRAINAGE AREA - 1566 SQ. M.
WHITEMOUTH LAKE
Rat River
Scale in Miles
Roseau River
Warroad
51°
50°
49°
97°
96°

PLATE II A


Elevations in Feet above Sea Level
Winnipeg River Seven Sisters Falls
Whitemouth Falls
N. Bdy Sec 28 Tsp 13 Rge II
N. Bdy Sec 21 Tsp 13 Rge II
N. Bdy Sec 16 Tsp 13 Rge II
N. Bdy Sec 9 Tsp 13 Rge II
N. Bdy Sec 4 Tsp 13 Rge II
N. Bdy Sec 33 Tsp Rge
N. Bdy Sec 28 Tsp 12 Rge II
N. Bdy Sec 22 Tsp 12 Rge II
N. Bdy Sec 15 Tsp 12 Rge II
N. Bdy Sec 11 Tsp 12 Rge II
N. Bdy Sec 2 Tsp 12 Rge II
N. Bdy Sec 36 Tsp 13 Rge II
C.P.R.Y. Main Line Bridge
Power Site No. 1
Power Site No. 2
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
J. B. CHALLIES, SUPT.
MANITOBA POWER SURVEY

PROFILE OF WHITEMOUTH RIVER SHOWING POSSIBLE POWER CONCENTRATIONS

Compiled for the Manitoba Public Utilities Commission

Nov. 1913

Douglas L. McLean ... Chief Engineer
Stuart J. Scott ... Asst. Chief Engineer

TABLE No. 26.

Daily Gauge Height and Discharge, Whitemouth River at Traffic Bridge, Whitemouth, for 1912.

Day.	May.		June.		July.		August.		September.		October.		November.		December.	
	Gauge Height	Discharge	Gauge Height	Discharge	Gauge Height.	Discharge	Gauge Height	Discharge	Gauge Height	Discharge	Gauge Height	Discharge	Gauge Height.	Discharge	Gauge Height.	Discharge
	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec.-ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec.-ft.	Feet.	Sec. ft.
1			4·37	1829	1·76	347	3·30	1130	3·67	1356	4·77	2109	3·20	1505		
2			4·05	1605	1·66	304	3·04	982	3·71	1382	4·68	2046	3·94	1531		
3			3·92	1518	1·54	256	2·93	922	3·70	1375	4·52	1934	4·00	1570		
4			4·10	1610	1·51	244	2·61	746	3·75	1408	4·49	1913	3·91	1512		
5			4·15	1675	1·50	240	2·60	740	4·23	1731	4·41	1857	3·84	1466		
6			4·05	1605	1·90	410	2·58	730	4·11	1647	4·38	1836	3·75	1408		
7			3·82	1453	1·95	433	2·62	751	4·02	1584	4·32	1794	3·62	1323		
8			3·76	1414	2·34	610	2·73	812	3·91	1512	4·55	1955	3·51	1256		
9			3·64	1336	2·55	715	2·92	916	3·87	1486	4·80	2130	3·42	1202		
10			3·24	1094	2·60	740	2·92	916	3·92	1518	4·80	2130	3·36	1166		
11			3·23	1088	2·64	762	2·91	911	3·97	1551	4·79	2123	3·31	1136		
12			3·04	982	2·63	757	2·91	911	3·99	1564	4·75	2095	3·28	1118		
13			3·02	971	3·14	1037	2·72	806	3·98	1557	4·71	2067	3·22	1082		
14			2·98	949	3·46	1226	2·65	768	3·96	1544	4·60	1990	3·19	1065		
15			2·82	861	3·72	1388	2·57	725	3·93	1525	4·47	1899	3·16	1048		
16			2·78	839	3·77	1421	2·52	700	4·18	1696	4·19	1703	3·12	1026	1·71	
17			2·56	720	3·77	1421	2·38	630	4·30	1780	4·10	1640	3·12	1026		
18			2·54	710	3·76	1414	2·32	600	4·25	1745	3·92	1518	3·06	993		
19			2·51	695	3·76	1414	2·28	581	4·18	1696	3·91	1512	3·02	971		
20			2·50	690	3·46	1226	2·06	482	3·95	1538	3·88	1492	3·00	960		
21			2·36	620	3·38	1178	2·04	473	4·53	1941	3·72	1388	2·91	911		
22			2·20	545	3·28	1118	2·12	509	4·98	2256	3·64	1336	2·86	883		
23			2·18	536	3·39	1184	2·22	554	5·08	2326	3·52	1262	2·78	839		
24			2·16	527	3·58	1298	2·35	615	5·14	2375	3·42	1202	2·94			
25			2·16	527	3·73	1395	2·41	645	5·12	2361	3·21	1076	3·16			
26			2·15	523	3·80	1440	2·44	660	5·08	2326	3·06	993	3·32			
27			2·13	514	3·84	1466	2·46	670	5·00	2270	3·18	1238	3·38			
28			2·11	505	3·92	1518	2·59	690	4·99	2263	3·66	1319	3·42			
29	4·42	2144	2·00	455	3·81	1417	2·52	700	4·90	2200	3·76	1414	3·42			
30	4·43	2154	1·86	392	2·67	1356	2·92	916	4·85	2165	3·82	1453	3·42			
31	4·56	1962			3·48	1238	3·52	1262			3·84	1466				

TABLE

Daily Gauge Height and Discharge, Whitemouth

Day.	January.		February.		March.		April.		May.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·34		1·12				3·33	1279
2									3·29	1254
3									3·21	1202
4									3·15	1164
5									3·12	1145
6									3·09	1126
7									3·00	1068
8					1·14		5·11	2418	3·00	1068
9							5·32	2553	2·92	1017
10							5·42	2617	2·92	1017
11							5·82	2873	2·96	1042
12					1·14		6·25	3148	2·94	1030
13			1·16				5·48	2655	2·91	1010
14							4·96	2322	2·88	991
15							4·88	2271	2·80	940
16							4·82	2233	2·70	876
17							4·76	2194	2·62	825
18							3·29	1254	2·62	825
19							3·25	1228	2·58	799
20							3·25	1228	2·52	761
21							3·22	1209	2·49	742
22			1·14		1·14		3·21	1202	2·45	716
23							3·46	1362	2·45	716
24							3·59	1446	2·43	703
25	1·34						3·66	1490	2·41	690
26							3·72	1529	2·39	678
27							3·72	1529	2·35	652
28							3·70	1516	2·35	652
29							3·62	1465	2·33	639
30							3·50	1388	2·30	620
31									2·28	607

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No. 27.

River at Traffic Bridge, Whitemouth, for 1913.

Days.	June.		July.		August.		September.		October.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	2·30	620	2·36	658	1·46	160	2·08	479	1·38	138
2	2·27	601	2·53	767	1·42	149	2·03	447	1·34	128
3	2·25	588	2·51	754	1·36	133	1·95	396	1·26	110
4	2·25	588	2·48	735	1·34	128	1·93	383	1·24	106
5	2·25	588	2·36	658	1·28	114	1·88	351	1·28	114
6	2·33	639	2·28	607	1·28	114	1·83	319	1·33	126
7	2·61	818	2·19	550	1·22	102	1·76	288	1·31	121
8	2·52	761	2·06	466	1·18	94	1·71	255	1·29	116
9	2·43	703	2·06	466	1·14	87	1·63	221	1·38	
10	2·35	652	2·00	428	1·11	82	1·68	242	1·46	
11	2·23	575	2·08	479	1·08	77	1·79	295	1·58	
12	2·18	543	2·18	543	1·08	77	1·62	216	2·58	
13	2·21	562	2·76	914	1·04	72	1·60	208	2·75	
14	2·17	537	3·05	1100	1·62	216	1·55	190	3·01	
15	2·08	479	3·10	1132	1·84	326	1·48	166	3·06	
16	2·08	479	3·26	1284	2·23	575	1·46	160	3·09	
17	1·88	351	2·95	1036	2·62	825	1·38	138	3·03	
18	1·86	338	2·83	959	2·76	914	1·46	160	2·94	
19	1·74	270	2·61	818	2·71	882	1·58	201	2·97	
20	1·76	280	2·54	774	2·66	850	1·54	186	2·90	Ice.
21	1·68	242	2·36	658	2·63	831	1·51	176	2·88	
22	1·67	237	2·20	556	2·54	774	1·50	172	2·78	
23	1·60	208	2·20	556	2·48	735	1·48	166	2·77	
24	1·58	201	2·13	511	2·46	722	1·48	166	2·70	
25	1·52	179	2·08	479	2·38	671	1·46	160	2·66	
26	1·49	169	1·96	402	2·38	671	1·42	149	2·60	
27	1·45	158	1·82	313	2·29	614	1·43	152	2·51	
28	1·45	158	1·69	246	2·21	562	1·41	146	2·56	
29	1·67	237	1·68	242	2·18	543	1·38	138	2·53	
30	1·82	313	1·55	190	2·12	505	1·36	133	2·51	
31			1·54	186	2·14	518			2·36	

The Brokenhead River.

A.—LOCATION.

The Brokenhead river (see plate No. 11) flows into the southeasterly section of lake Winnipeg. It drains a long narrow strip of land lying between the watersheds of the Winnipeg and Whitemouth rivers on the east, and the Red river on the west.

B.—RIVER BASIN.

The drainage area of the river is 910 square miles, its greatest width being twenty-two miles and its length, from mouth to head-waters, seventy-five miles. The greater part of this area is low-lying and marshy land, though along the banks of the river a certain amount of reclamation work has been done in the lower reaches, and the land is broken up for farming purposes.

In the upper basin of the river much of the land is swampy and cannot be settled or cultivated until some system of drainage has been carried out.

C.—BED AND BANKS.

The bed and banks of the river are composed of sandy clay, intermixed in some sections with large boulders.

The banks, as a general rule, are low-lying, and rise above the bed of the stream from five to ten feet.

D.—RUN-OFF.

(*a*) *Rainfall.*—From rainfall records obtained, it is found that the mean annual precipitation in the drainage basin of the river is 22 inches.

(*b*) *Discharge Measurements.*—A metering station was established on the river at the village of Sinnot in May of the year 1912 by the Manitoba Hydrographic Survey, and since that time continuous observations as to flow have been made.

These observations include eleven meterings taken during the different stages of the river, the results of which are shown in table No. 28.

Daily gauge height records have also been kept at the metering station and these, with their estimated daily discharges, are shown in tables No. 29 and No. 30.

E. POWER POSSIBILITIES.

There has been no survey work done on this river with the view to locating power sites, and it is doubtful, considering the nature of the country through which it flows, if there are any such on the river. If any should be located, the development of the same would necessarily be for operation only through the open season, as it has been found that flow is liable to be completely cut off during the winter months.

The fall in the river from the village of Sinnot to lake Winnipeg, a distance of approximately forty miles, is seventy-two feet, or 1·8 feet per mile.

F.—WATER-POWER.

During the year ending October 31, 1913, it will be seen from the discharge tables, that the flow was entirely cut off during the months of January, February and March, with the extremely low estimated flow of 10 second-feet in December. Taking into account these conditions, it is found necessary to base any computations as to avail-

Winnipeg & Whitemouth Rivers
Falls at Rat of Portage

2nd May 1913
Whitemouth River - Rapids at mouth of River from Right Bank

able water-power on the stimates of flow for a partial year, as no continuous operation would have been possible on this river during the above period.

Based on the estimates of flow for the year ending October 31, 1913, the following table gives the power available per foot head at an 80 per cent efficiency, and is computed on the lowest monthly mean flow (89 second-feet), for the period of seven months from April to October. This estimated power only relates to the period as above stated:—

Head in Feet.	Estimated Horse-power at 80 per cent Efficiency.
	Flow 89 sec.-ft.-Period April to Oct.
1	8
10	80
20	160

TABLE No. 28.

Discharge Measurements of Brokenhead River at Sinnot, for 1912-13.

Date.	Hydrographer.	Meter No.	Width.	Area of sections.	Mean velocity.	Gauge height.	Discharge.
1912.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 30	G. H. Burnham	1187	88	382	1·74	3·79	665
June 20	" "	1187	88	198	0·95	1·94	188
July 15	" "	1187	88	201	0·86	1·81	173
Aug. 9	W. G. Worden	1187	86	136	0·42	1·21	58
Sept. 3	" "	1187	87	166	0·52	1·54	86
Oct. 15	R. H. Nelson	1186	76	341	1·39	3·18	474
1913							
Jan. 24	Alex. Pirie	.....	.....	.....	.....	.....	0*
April 19	" "	1186	89	298	1·50	2·98	447
May 9	G. Ebner	1186	85	228	1·16	2·14	264
Aug. 15	W. J. Ireland	1469	82·5	224	0·98	2·23	219
Sept. 27	C. O. Allen	1435	80	155	0·56	1·40	87

* River frozen to bottom.

TABLE No. 29.

Daily Gauge Height and Discharge, Brokenhead River, near Sinnot, for 1912.

Date.	June.		July.		August.		September.		October.		November.		December.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.
	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec.-ft	Feet.	Sec.-ft.	Feet.	Sec. ft.	Feet.	Sec.-ft.
1			0·92	27	1·69	134	1·40	75	4·01	690	2·70	376		
2			0·85	24	1·59	110	1·47	87	3·95	676	2·79	398		
3			0·80	21	1·49	90	1·51	94	3·85	652	2·79	398	1·72	
4			0·74	18	1·41	77	1·91	186	3·72	621	2·70	376		
5			0·70	16	1·31	62	1·90	184	3·60	592	2·66	366		
6			0·71	17	1·31	62	1·84	170	3·55	580	2·60	352		
7			0·74	18	1·28	59	1·80	160	3·51	570	2·59	350		
8	3·52	573	0·83	23	1·23	53	1·83	167	3·50	568	2·60	352		
9	3·40	544	0·80	21	1·21	51	1·90	184	3·48	563	2·60	352		
10	3·23	503	0·91	27	1·21	51	1·85	172	3·43	551	2·68	371	0·90	
11	3·05	460	0·95	29	1·20	50	1·84	170	3·40	544	2·70	376		
12	2·88	419	2·60	352	1·19	49	1·83	167	3·39	542	2·68	371		
13	2·73	383	2·14	242	1·21	51	1·84	170	3·32	525	2·63	359		
14	2·60	352	1·75	148	1·20	50	2·52	333	3·29	518	2·60	352		
15	2·46	318	1·83	167	1·15	45	2·66	366	3·20	496	2·58	347		
16	2·32	285	1·72	141	1·11	41	2·84	410	3·15	484	2·54	338		
17	2·24	266	1·85	172	1·08	38	3·11	474	3·09	470	2·49	326	0·70	
18	2·14	242	1·74	146	1·05	36	2·99	446	3·00	448	2·45	316		
19	2·06	222	1·68	131	1·00	32	3·19	494	2·97	441	2·40	304		
20	1·98	203	1·63	119	0·98	31	3·28	515	2·90	424	2·38	299		
21	1·80	160	1·55	102	0·95	29	3·98	683	2·82	405	2·20	256		
22	1·79	158	1·52	96	0·90	26	4·00	688	2·71	378	2·08	227		
23	1·68	131	1·54	100	0·90	26	4·10	712	2·69	374	1·80	160		
24	1·59	110	1·75	148	1·00	32	4·27	753	2·64	362	1·90	184	0·60	
25	1·35	68	1·74	146	0·99	31	4·27	753	2·59	350	2·59	.....		
26	1·39	74	1·70	136	1·01	33	4·29	758	2·54	338	2·60	... ...		
27	1·29	60	1·97	186	1·05	36	4·28	755	2·49	326	2·50	... ...		
28	1·20	50	2·01	210	1·12	42	4·20	736	2·45	316	2·49	... ...		
29	1·01	33	1·96	198	1·19	49	4·15	724	2·40	304	2·45	. .		
30	1·00	32	1·84	170	1·98	203	4·10	712	2·40	304	2·40	. ..		
31	...	.....	1·79	158	1·40	75	.....	.....	2·50	328	....	.....	0·50	

TABLE No. 30.

DAILY GAUGE HEIGHT AND DISCHARGE, Brokenhead River, near Sinnot, for 1913.

Date.	April.		May.		June.		July.		August.		September.		October.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			2·65	364	1·50	92	2·95	436	0·69	16	2·49	326	1·25	56
2			2·58	347	1·53	98	3·00	448	0·67	14	2·46	318	1·20	50
3			2·53	335	1·50	92	2·98	443	0·60	12	2·35	292	1·18	48
4			2·49	326	1·48	89	2·80	400	0·59	12	2·26	270	1·15	45
5			2·41	306	1·45	83	2·68	371	0·57	11	2·08	208	1·10	40
6			2·40	304	1·70	136	2·45	316	0·56	11	1·90	184	1·08	38
7			2·30	280	1·84	170	2·30	280	0·53	10	1·90	184	1·10	40
8			2·23	268		157	2·20	256	0·50	9	1·80	160	1·20	50
9			2·16	246		143	1·90	184	0·48	8	1·79	158	1·35	68
10			2·10	232		129	1·78	155	0·60	12	1·84	170	1·46	85
11			2·08	227		116	1·95	196	0·59	12	2·00	208	1·65	124
12			2·08	227		102	1·94	194	0·54	10	2·04	218	1·80	169
13			2·07	225		88	2·00	208	0·50	9	2·09	230	1·90	184
14			2·07	225		74	2·10	232	0·49	9	2·05	220	2·00	208
15			2·03	215	1·30	61	1·97	201	1·54	100	2·00	208	2·00	208
16			2·00	208	1·24	54	1·90	184	2·50	328	1·96	198	1·95	196
17			1·96	198	1·20	50	1·88	179	2·65	364	1·90	184	1·90	184
18			1·94	194	1·10	40	1·84	170	2·70	376	1·83	167	1·88	179
19	1·50		1·89	182	1·06	37	1·70	136	2·75	388	1·70	136	1·80	160
20			1·84	170	0·90	26	1·55	102	2·70	376	1·60	112	1·78	155
21			1·80	160	0·80	21	1·46	85	2·60	352	1·60	112	1·74	146
22			1·75	148	1·00	32	1·40	75	2·54	338	1·58	108	1·70	136
23			1·74	146	0·94	28	1·30	61	2·53	335	1·53	98	1·64	122
24			1·70	136	0·86	24	1·28	59	2·53	335	1·50	92	1·60	112
25			1·68	131	0·80	21	1·18	48	2·52	333	1·45	83	1·58	108
26			1·65	124	0·79	20	1·09	39	2·51	330	1·47	80	1·58	108
27			1·60	112	0·70	16	1·00	32	2·50	328	1·40	75	1·57	106
28			1·59	110	0·90	26	0·90	26	2·49	326	1·36	69	1·56	104
29	2·80	400	1·56	104	2·18	251	0·80	21	2·48	323	1·33	65	1·56	104
30	2·72	381	1·53	98	2·80	400	0·75	19	2·50	328	1·30	61	1·55	102
31			1·50	92			0·70	16	2·50	328			1·54	100

The Roseau River.

A.—LOCATION.

The Roseau river is the largest tributary entering the Red river from the east, in its course through the province of Manitoba. It has its head-waters in the low lands lying to the west of the Lake of the Woods. About half of its total length lies south of the international boundary, and it joins the Red river approximately ten miles north of same.

The general direction of the river is northwest, and similar to the Red river its course is very winding throughout its length.

B.—RIVER BASIN.

The drainage basin of the river covers an area of 1987 square miles, 1097 of which are in the State of Minnesota, the balance, 890, being in Manitoba.

The greater part of this area is flat land, that in the upper reaches being such that it was impossible to cultivate the same without artificial drainage. In connection with this work, forty miles of the upper section of the river in Minnesota has been straightened and widened to eighty feet, and the land on either side for a considerable distance drained into same, with ditches spaced one mile apart.

The effect of this drainage is shown in the lower reaches of the river by the rapid rise apparent during times of heavy rainfall.

C.—BED AND BANKS.

The course of the river from its source to its mouth lies through level country, with no perceptible valley of any extent. The banks cut sharply down from the prairie level to the bed of the stream. The nature of these banks is stated to be invariably a heavy clay, which material also forms the bed of the river. The height of these banks varies from ten to twelve feet.

D.—TIMBER AND VEGETATION.

A large percentage of the land throughout the drainage basin of the river in the province of Manitoba is cultivated, and there is a very small amount of standing timber. What there is consists mostly of small elm, ash and oak, very little of which is large enough to have commercial value except as firewood.

E.—SETTLEMENTS.

In the course of the river through Manitoba, three settlements are met with. The first located close to the head-waters is the village of Sprague on the Ridgeville branch of the C.N.R. The second is Stuartburn, on the same line of railroad. The third is Dominion City, located at the crossing of the C.P.R., Emerson branch. These villages are all small, the largest being Dominion City, with a population of about two hundred.

F.—RUN-OFF.

(*a*) *Rainfall.*—From rainfall records of the northern part of Minnesota covering a period of thirty years and at Oak Bank, to the north of the drainage area, covering a period of twenty-two years, it is found that the mean annual precipitation in the watershed of the Roseau is 22 inches.

(*b*) *Discharge Measurements.*—A metering station was established on the river at Dominion City by the Manitoba Hydrographic Survey in May, of 1912. During the summer of that year and the winter of 1912-13, nine discharge measurements were made, the results of which are shown in table No. 31.

This station was abandoned during the spring of the present year to escape the effects of backwater from a dam placed below the metering section by the C.P.R., for water-supply purposes.

In April of 1913 the same survey established a metering station on Baskerville's traffic bridge, about twenty-five miles upstream from Dominion City, and observations, including daily gauge height records and discharge measurements, have been made at this point during the present season. These discharge measurements, eight in number, are shown in table No. 33.

The estimated daily discharges, based on the above-mentioned discharge measurements for the stations at Dominion City and Baskerville's Bridge, will be found in tables No. 32 and No. 39.

G.—POWER POSSIBILITIES.

No surveys for the purpose of locating power sites have been made on this river, and information as to the possibility of concentrating the natural fall at any points throughout its course is very meager. Local authority reports that in the neighbourhood of Dominion City there is a possible development of 15 feet head, but this has not been investigated.

From the village of Sprague, near the head-waters to Dominion City, a distance of about two hundred miles by river, there is a difference in elevation of 287 feet, or about 1·4 feet to the mile.

Should any development be made on this river, and a continuous supply of power be required, it would necessitate the installation of an auxiliary steam plant to carry it over points of extreme low flow, as the absence of lakes or storage areas in the upper reaches of the river make the possibility of storage regulation very slight.

H.—WATER-POWER.

From the estimates of flow for the year ending October 31, 1913, it will be seen that during the months of February and March the flow was entirely cut off, and the following table gives the power available per foot of head at an 80 per cent efficiency, based on the lowest monthly mean flow (40 second-feet), for the open six months of the year, viz., from May to October. This estimate of power only relates to the period as stated.

Head in Feet.	Estimated Horse-power at 80 per cent Efficiency.
	Flow 40 Sec.-ft. Period May to October.
1	3·6
10	36
20	72

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TABLE No. 31.

DISCHARGE MEASUREMENTS of Roseau River at Dominion City, 1912.

Date.	Hydrographer.	Meter No	Width.	Area of Section.	Mean Velocity.	Gauge Height.	Discharge.
1912.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 21	S. S. Scovil	1187	81·0	334·2	1·22	3·79	408
June 18	G. H. Burnham	1187	73·5	238·9	0·65	2·42	155
July 11	G. H. Burnham	1187	68·0	123·5	0·252	0·95	31
Aug. 7	W. G. Worden	1187	74·0	216·1	0·634	2·225	137
" 24	W. G. Worden	1187	72·1	199·3	0·515	1·975	103
Oct. 19	G. J. Lamb	1187	85·0	553·0	2·16	6·85	1195
Nov. 1	G. J. Lamb	1187	85·5	581·8	2·19	7·00	1273
1913.							
Jan. 13	G. J. Lamb	1374	56·0	25·2	·93	2·78	23·5 [1]
Feb. 25	A. Pirie						0 [2]

[1] Ice measurement. [2] No flow; frozen to bottom.

TABLE No. 32.

DAILY GAUGE HEIGHT AND DISCHARGE, Roseau River at Traffic Bridge, Dominion City, for 1912.

Day.	MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	...	...	3·79	410	1·14	41	1·74	83	1·96	103	4·43	577	7·01	1248	3·42	
2	...	...	3·50	336	1·04	36	1·90	97	1·97	104	4·65	634	6·80	1193	3·22	
3	...	...	3·53	344	1·02	35	2·05	113	2·02	109	4·81	676	6·60	1141	2·73	
4	...	...	3·52	341	1·02	35	2·13	121	2·20	129	4·91	702	6·50	1115	2·35	
5	...	...	3·42	318	0·97	33	2·16	125	2·24	133	5·03	733	6·16	1027	2·88	
6	...	...	3·48	332	0·93	30	2·22	131	2·20	129	5·91	962	5·81	936	2·63	
7	...	...	3·41	316	1·02	35	2·23	132	2·22	131	5·27	795	5·61	884	2·82	
8	...	...	3·35	304	0·96	32	2·18	127	2·18	127	5·44	839	5·52	860	2·78	
9	...	...	3·29	292	1·08	38	2·03	110	2·17	126	5·44	839	5·43	837	2·58	
10	...	...	3·21	276	1·11	40	1·94	101	2·22	131	5·61	884	5·31	806	2·54	
11	...	...	3·14	263	0·95	31	1·83	91	2·23	132	5·81	936	5·24	787	2·37	
12	...	...	3·00	238	1·19	44	1·83	91	2·14	122		1000	5·11	754	2·11	
13	...	...	2·98	235	1·18	44	2·03	110	2·17	126		1030	4·98	720	1·91	
14	...	...	2·90	222	1·30	51	2·11	119	2·20	129		1060	4·80	673	1·77	
15	...	...	2·85	214	1·41	59	2·17	126	2·23	132		1090	4·87	691	1·70	
16	...	...	2·76	200	1·54	68	2·14	122	2·25	134		1120	5·20	777	1·61	
17	...	...	2·63	182	1·58	71	2·18	127	2·24	133		1150	5·42	834	1·56	
18	...	...	2·49	163	1·58	71	2·20	129	2·25	134		1180	4·71	650	1·51	
19	...	...	2·20	129	1·61	73	2·20	129	2·24	133	Water above gauge.					
20	3·78	408	2·28	138	1·66	77	2·23	132	2·35	146	6·87	1211	5·11	754	1·47	
21	3·79	410	2·17	126	1·71	81	2·23	132	2·59	177	6·78	1188	5·27	795	1·46	
22	3·79	410	2·00	107	1·78	86	2·16	125	2·83	211	6·92	1224	5·14	761	1·45	
23	3·81	416	1·88	95	1·85	93	2·05	113	2·88	219	7·08	1266	5·87	951	1·43	
24	3·77	405	1·74	83	1·91	98	1·97	104	2·91	224	7·01	1248	5·06	741	1·43	
25	3·71	390	1·63	74	1·82	90	1·94	101	2·98	235	7·13	1279	4·78	668	1·43	
26	3·64	371	1·51	66	1·72	82	1·91	98	3·22	278	7·31	1326	4·93	707	1·43	
27	3·67	379	1·43	60	1·64	75	1·89	96	3·44	323	7·20	1297	.....	640	1·43	
28	3·82	418	1·33	53	1·64	75	1·92	99	3·69	384	7·21	1300	.....	580	1·43	
29	4·01	468	1·20	45	1·73	82	1·93	100	3·97	457	7·20	1297	4·24	527	2·48	
30	4·01	468	1·20	45	1·69	79	2·03	110	4·24	527	7·38	1344	3·81	416	3·11	
31	3·92	444		...	1·71	81	2·09	117	.....		7·42	1354	3·63	369	3·01	
											7·11	1274	.....	.....	2·98	

TABLE No. 33.

DISCHARGE MEASUREMENTS of Roseau River, at Baskerville's Bridge, 1913.

Date.	Hydrographer.	Meter No.	Width.	Area of Section.	Mean Velocity.	Gauge Height.	Discharge.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Apr. 12.	G. H. Burnham	1496		483·7	2·16	8·00	1,041
" 23	A. Pirie	1186		910·3	2·25	12·54	2,044
" 30	E. Bankson	1469		647·3	2·42	10·88	1,569
May 14	E. Bankson	1469		354·5	1·69	6·01	560
June 28	G. Ebner	1186		145·6	0·88	2·94	128
July 31	A. Pirie	1496		165·6	1·03	2·90	171
Aug. 20	C. O. Allen	1435		94·0	0·44	1·55	42
Sep. 18	C. O. Allen	1435		105·4	0·54	1·72	57

TABLE No. 34.

DAILY GAUGE HEIGHT AND DISCHARGE, Roseau River, near Baskerville's Bridge, for 1913.

Date.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			10·46	1517	3·98	264	3·28	186	2·65	126	2·32	97	1·41	33
2			9·85	1389	·87	250	·10	168	·51	113	·23	89	·40	32
3			·74	1365	·80	242	·03	161	·41	104	·15	83	·40	32
4			·49	1313	·79	241	·08	166	·30	95	·08	77	·39	31
5			·04	1218	·78	240	·08	166	·20	87	·06	76	·41	33
6			8·47	1099	3·88	252	2·99	157	2·09	78	2·01	72	1·48	33
7			·03	1006	·77	239	·92	150	1·92	65	1·92	65	·52	39
8			7·68	933	·79	241	·96	154	·89	63	·81	58	·55	41
9			·29	851	·93	258	·85	144	·78	56	·70	50	·51	39
10			·03	796	·97	262	·77	136	·68	49	·89	63	·52	39
11			6·74	735	3·98	264	2·88	146	1·71	51	1·79	56	1·60	44
12			·55	696	4·00	266	·97	155	·61	45	·72	51	·75	54
13			·27	637	·00	266	3·08	166	·59	43	·68	49	·84	60
14			5·96	572	·07	274	2·99	157	·54	40	·67	48	·80	57
15			·99	578	·07	274	·99	157	·49	37	·67	48	2·29	
16			5·96	572	3·97	262	3·09	167	1·52	39	1·67	48	2·60	
17			·63	510	·79	241	·90	254	·39	31	·61	45	·74	
18			·40	469	·77	239	·32	190	·39	31	·79	56	·90	
19			·24	440	·73	234	·40	198	·41	33	·78	56	·88	
20			·17	428	·63	223	·41	199	·47	36	·79	56	·81	
21			5·11	419	3·46	205	3·45	204	1·79	56	1·71	51	2·62	
22			·03	406	·29	187	·49	208	·63	46	·71	51	·40	
23	12·54	1953	4·89	384	·19	177	·41	199	·71	51	·68	49	·59	
24	·48	1941	·74	363	·09	167	·39	197	·71	51	·71	51	·63	
25	·69	1985	·69	356	·02	160	·36	194	·85	61	·68	49	·61	
26	11·99	1838	4·58	340	2·78	137	3·30	188	2·06	76	1·63	46	2·42	
27	·46	1727	·44	322	·69	129	·23	181	·45	108	·59	43	·41	
28	·69	1775	·29	303	3·39	197	·13	171	·52	114	·51	39	·34	
29	·39	1712	·24	296	·31	189	·01	159	·52	114	·47	36	·65	
30	10·96	1622	·19	290	·56	216	2·98	156	·47	109	·42	33	·03	
31			·05	272			·87	145	·38	101			·60	

The Red River.

A.—LOCATION.

The source of the Red river is in the western central part of the state of Minnesota. Its first flow is in a southerly direction for a distance of sixty miles, then to the west for one hundred miles to the town of Breckenbridge, on the boundary line between the states of Minnesota and North Dakota. From this town to the international boundary the river forms the dividing line between the two above-mentioned states. Continuing in its course through Manitoba the river empties into the southern part of lake Winnipeg.

B.—DIRECTION.

The general direction of the river, after passing its first flow to the south and west, as above noted, is almost directly north and, from the town of Breckenbridge to the city of Winnipeg, a distance of two hundred and fifty miles, the general course of the river does not vary from a straight line more than five miles. At Winnipeg it bears away to the eastward, and the final thirty-five miles of its course lie in a north-easterly direction.

An idea of the extremely winding nature of the river can be gathered from the fact that in its course from Breckenbridge to Winnipeg, though the general course does not vary to any great extent from a straight line, yet the length of the actual river channel is more than double the distance by direct line. This characteristic is common throughout its length.

C.—RIVER BASIN.

The drainage basin of the river covers an area of 116,347 square miles, of which 42,547 are in Minnesota and Dakota, 50,500 in Saskatchewan and 23,300 in Manitoba.

A large part of this area is made up by the area of its largest tributary, the Assiniboine river.

The principal tributaries entering the river in Manitoba are the Roseau, the Rat and the Seine, from the east, and the Assiniboine and Morris rivers from the west. The Pembina river, though the greater part of its drainage area lies in southern Manitoba, joins the Red south of the international boundary.

D. BED AND BANKS.

The entire basin is practically a level plain, varying in width from 50 to 200 miles, and with a length of water over 300 miles. There is a gentle slope from the sides of the valley to the center, of about the same gradient as from the head-waters to the mouth of the river, namely, about one foot to the mile. Down the center of the valley the river has cut a sharp, winding channel, dropping from twenty to fifty feet below the level of the plains on either side. The banks of this channel are composed of a gravelly clay, and though no rock outcrops show in the course of the river, the bed, close to the mouth, is underlaid with a stratum of rocks at a depth varying from ten to twenty feet.

E. TIMBER AND VEGETATION.

Throughout the Red River valley lying in Manitoba there is very little standing timber except in the extreme easterly section of same. Along the course of the river, occasional clumps of elm and ash are met with, though not of sufficient extent to warrant extensive lumbering operations.

The land being mostly prairie, and being along the line of first immigration into Manitoba, naturally it is one of the oldest settled districts in the province. The larger percentage of the land is settled and is continuously worked as farm land, it being of a very productive nature.

F.—NAVIGATION.

The river is navigable for boats of light draught from the mouth of the river up to Grand Forkes, Minn. Prior to the construction of the railroads it was used extensively during the open season for freight and passenger service. Since the coming of the railroads, however, river traffic could not compete with this faster mode of transportation, and has gradually died out.

There has been a considerable revival in river travel in the lower reaches of the river since the installation, by the Dominion Government, of the St. Andrews dam and locks near the mouth of the river. This dam, which raises the water level at Winnipeg about eight feet, ensures the boats from lake Winnipeg a safe passage up the river to the city during the summer months.

G.—SETTLEMENTS.

In the course of the river through Manitoba, the first town passed through is Emerson, located at the international boundary, and from this point to Winnipeg there are located a number of smaller towns. These towns are in some instances removed a mile from the river, being located on the C.N.R., which line closely parallels the course of the river for the entire distance. Between the city of Winnipeg and the mouth of the river the largest town is Selkirk, located about 22 miles below the city, but there are small settlements scattered throughout almost the entire distance.

H.—RUN-OFF.

(*a*) *Rainfall.*—From records in central Minnesota covering a period of thirty years, it is found that the mean annual precipitation at the head-waters of the river is 24 inches, and the records at Winnipeg, covering a period of forty years, give the mean annual rainfall at that point to be 21 inches.

In the western part of the drainage area of the river, the rainfall is noticeably less than that noted above, and does not average more than 17 inches.

(*b*) *Discharge Measurements.*—A metering station was located on the river at the town of Emerson, in May of the year 1912, and during the years of 1912 and 1913, nineteen discharge measurements were made at different stages of the river. The results obtained from these measurements are shown in table No. 35.

A continuous record of gauge heights has also been kept since this station was established, and these with the estimated daily discharges, are shown in tables No. 36 and No. 37.

I—HIGH AND LOW FLOW.

The rise and fall of stage in the Red river throughout the year is, as a rule, gradual, with the exception of during the spring break-up. At this time there are liable to be excessive floods. These floods are caused by the release of the water held in the form of snow and ice in the warmer southern reaches of the river, some time previous to the break-up in the colder sections near the mouth. As it reaches the section of the river where the break-up has not yet taken place, this water, not being able to obtain easy egress, backs up and frequently forces the stage of the river to a height of 20 to 30 feet above normal water level.

J.—WATER-POWER.

In the course of the river through the province the only feasible power development is located at Lockport, where the construction of the Dominion Government dam at the St. Andrews rapids has concentrated a head of approximately 15 feet.

Any development at this point would necessarily be for operation only during the period of open water on the river, when the dam is held closed as an aid to navigation, usually between the months of May and October.

The following table gives the estimated power available at this site, based on an 80 per cent efficiency. The discharge on which this table is based is an estimated low flow of 2,400 second-feet, and has been arrived at from the information at hand as to the lowest mean monthly flow of the river as it enters the province and of the tributaries entering the river in its course between Emerson and Lockport. This discharge is estimated only for six months ending October 31, 1913, and is subject to revision.

Head in Feet.	Estimated Horse-Power at 80 Per Cent. Efficency.
	Minimum Flow 2,400 sec.-ft. Period May 1 to December.
15	3,270

TABLE No. 35.

Discharge Measurements of Red River, at Emerson, 1912-13.

Date.	Hydrographer.	Meter No.	Width.	Average of Section.	Mean Velocity.	Gauge Height.	Discharge.
1912.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 5	S. S. Scovil.	1187	222·2	876	1·88	4·00	1646
" 18	S. S. Scovil.	1187	245	1353	2·25	6·46	3045
June 12	G. H. Burnham.	1187	243	885	1·92	4·26	1699
" 15	G. H. Burnham.	1187	243	852	1·62	3·68	1380
July 9	G. H. Burnham.	1187	214	649	1·53	2·73	994
" 24	G. H. Burnham.	1187	213	682	1·70	3·09	1159
Aug. 6	W. G. Worden.	1187	214	679	1·74	3·05	1182
" 22	W. G. Worden.	1187	214	672	1·59	2·69	1070
Oct. 18	G. J. Lamb.	1187	242	1038	1·69	4·73	1754
" 31	G. J. Lamb.	1187	221	881	1·63	4·06	1436
1913.							
Jan. 15	G. J. Lamb.	1375	190	754	·66	2·55	500
Feb. 24	A. Pirie.	1062	185	625	·45	2·14	278
Apr. 10	G. H. Burnham.	1497	357	7190	3·37	28·65	24233
" 22	A. Pirie.	1186	304	3645	2·81	17·10	10230
" 29	E. Bankson.	1469	270	2437	2·44	11·47	5936
May 13	E. Bankson.	1469	244	1333	2·41	6·95	3211
July 30	A. Pirie.	1469	243	638	1·59	2·69	1015
Aug. 19	C. O. Allen.	1435	220	492	1·62	2·23	797
Sep. 19	C. O. Allen.	1435	222	751	1·96	3·73	1524

[1]Ice measurement taken 2½ miles below station.

12th June 1912
C.930
Emerson – Looking downstream from Bridge

May 2nd 1913
C.843
Whitemouth River – looking down 2nd Rapids from Whitemouth

TABLE No. 36.

DAILY GAUGE HEIGHT AND DISCHARGE, Red River, at Emerson, for 1912.

DAY.	MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.	
	Gauge Height	Discharge.	Gauge Height	Discharge.	Gauge Height	Discharge.	Gauge Height	Discharge.	Gauge Height	Discharge	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec. ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.	1500	6·0	2650	3·4	1293	4·3	1715	2·53	942	6·5	2950	3·95	1542	3·45	
2	...	1520	5·86	2560	3·14	1184	4·0	1565	2·45	911	6·95	2225	3·95	1496	3·6	
3	3·98	1536	5·76	2511	3·0	1125	3·62	1390	2·38	886	7·3	3141	3·8	1473	3·8	
4	4·02	1575	5·62	2430	2·9	1086	3·3	1251	2·26	841	7·5	3565	3·85	1496	3·75	
5	4·23	1680	5·5	2365	2·79	1043	3·2	1209	2·35	875	7·35	3472	3·85	1496	3·7	
6	4·2	1665	5·38	2293	2·79	1043	3·09	1163	2·35	875	·72	3879	3·9	1519	3·65	
7	4·35	1740	5·26	2226	2·7	1008	3·05	1146	2·75	1028	·70	3255	3·85	1496	3·63	
8	4·5	1815	5·12	2147	2·6	969	2·94	1102	2·8	1047	6·7	3072	3·8	1472	3·6	
9	4·65	1895	4·95	2054	2·73	1020	2·69	1004	2·65	988	6·35	2860	3·8	1473	3·5	
10	4·8	1974	4·6	1868	2·72	1016	2·59	965	2·46	915	5·95	2621	3·8	1473	3·4	
11	5·23	2209	4·4	1765	2·7	1008	2·5	930	2·5	930	5·7	2476	3·8	1473	3·3	
12	5·36	2285	4·25	1690	2·69	1004	2·55	950	2·55	950	5·5	2360	3·8	1473	3·15	
13	6·08	2698	4·09	1610	2·8	1047	2·52	938	2·48	923	5·4	2304	3·85	1496	3·15	
14	6·29	2824	3·9	1519	2·65	988	2·45	911	2·32	863	5·3	2248	3·85	1496	3·15	
15	6·43	2908	3·74	1445	2·65	988	2·36	878	2·26	841	5·2	2192	3·75	1450		
16	6·48	2938	3·59	1376	2·68	1000	2·4	893	2·35	875	4·9	2027	3·7	1427		
17	6·47	2932	3·54	1353	2·68	1000	2·37	882	2·48	923	4·8	1974	3·6	1381		
18	6·47	2932	3·53	1349	2·7	1008	2·26	841	2·65	988	4·62	1879	3·6	1381	3·0	
19	6·45	2920	3·53	1349	2·73	1020	2·33	867	2·88	1078	4·57	1852	3·6	1381		
20	6·32	2842	3·53	1349	2·73	1020	2·60	969	3·0	1125	4·45	1790	3·5	1335		
21	6·25	2800	3·53	1349	2·8	1047	2·78	1039	3·08	1159	4·4	1765	3·4	1293	3·0	
22	6·0	2650	3·53	1349	2·9	1086	2·76	1031	3·05	1146	4·3	1745	3·29	1247		
23	5·9	2592	3·53	1349	3·0	1125	2·60	969	3·1	1167	4·15	1649	3·18	1201	2·9	
24	5·8	2534	3·51	1340	3·09	1163	2·50	930	3·3	1251	4·0	1565	3·27	1238		
25	5·7	2476	3·56	1363	3·15	1188	2·40	893	3·5	1335	3·9	1519	3·35	1272		
26	5·5	2360	3·63	1395	3·13	1180	2·48	923	3·65	1404	3·8	1473	3·4	1293	2·8	
27	5·68	2464	3·74	1445	3·3	1251	2·55	950	3·75	1450	3·8	1473	3·45	1314		
28	5·97	2633	3·87	1505	3·3	1251	2·47	923	4·0	1565	3·9	1519	3·45	1314		
29	6·05	2680	3·8	1473	3·22	1217	2·36	878	4·5	1815	4·0	1565	3·45	1314		
30	6·08	2698	3·64	1399	4·15	1640	2·30	856	5·6	2118	4·1	1615	3·4	1293		
31	6·19	2759			4·68	1910	2·49	926			4·0	1565				

TABLE

Daily Gauge Height and Discharge,

Day.	January.		February.		March.		April.		May.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	2·8						4·2	1665	10·15	5230
2							5·2	2192	9·95	5103
3							7·0	3255	8·7	4316
4	2·7						8·6	4253	8·5	4190
5			2·45		2·13		10·6	5514	8·4	4127
6							18·15	10925	8·3	4064
7							22·15	14863	8·0	3875
8	2·6						25·15	18597	7·8	3751
9							27·15	21591	7·6	3627
10							28·45	23906	7·4	3503
11							29·45	26020	7·2	3379
12			2·2		2·13		29·45	26020	7·1	3317
13							29·15	25360	6·9	3194
14	2·55						28·55	24103	6·8	3133
15							27·55	22255	6·6	3011
16							26·55	20633	6·5	2950
17							25·55	19163	6·4	2890
18	2·53						24·05	17115	6·3	2830
19			2·15		2·13		22·80	15603	6·2	2770
20							21·15	13793	6·1	2710
21							19·15	11825	6·0	2650
22	2·5						17·45	10337	6·0	2650
23							16·15	9304	5·9	2592
24							14·85	8354	5·9	2592
25							13·85	7651	5·85	2563
26			2·14		2·13		12·85	6971	5·7	2476
27							12·15	6513	5·55	2389
28							11·15	5866	5·5	2360
29	2·5						10·45	5419	5·4	2304
30							10·35	5355	5·4	2304
31					3·9				5·35	2276

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No. 37.

Red River, at Emerson, for 1913.

June.		July.		August.		September.		October.		Day.
Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
5·3	2248	3·25	1230	2·55	950	2·94	1102	2·62	977	1
5·2	2192	3·3	1251	2·6	969	3·0	1125	2·60	969	2
5·12	2147	3·3	1251	2·68	1000	2·8	1047	2·46	915	3
5·1	2136	3·27	1238	2·78	1039	2·72	1016	2·20	819	4
5·0	2080	3·25	1230	2·95	1106	2·6	969	2·20	819	5
4·95	2054	3·22	1217	3·2	1209	2·5	930	2·23	830	6
4·93	2043	3·12	1175	2·92	1094	2·43	904	2·27	845	7
4·9	2027	3·1	1167	2·87	1074	2·37	882	2·35	875	8
4·85	2000	3·0	1125	2·57	957	2·23	830	2·45	912	9
4·8	1974	3·0	1125	2·56	953	2·1	782	2·53	942	10
4·77	1957	2·9	1086	2·55	950	2·2	819	2·60	969	11
4·7	1924	3·17	1196	2·5	930	2·23	830	2·67	996	12
4·65	1895	3·4	1293	2·5	930	2·2	819	2·75	1027	13
4·55	1841	3·8	1473	2·4	893	2·4	893	2·90	1086	14
4·45	1790	4·2	1665	2·3	856	2·7	1008	3·15	1188	15
4·35	1740	4·4	1765	2·2	819	2·97	1113	3·40	1293	16
4·22	1675	4·3	1715	2·1	782	3·4	1293	3·63	1395	17
4·12	1625	4·25	1690	2·1	782	3·7	1427	3·74	1445	18
4·0	1565	4·1	1615	2·2	819	3·73	1441	3·74	1445	19
3·85	1496	3·95	1542	2·2	819	3·8	1473	3·80	1473	20
3·75	1450	3·75	1450	2·27	845	3·9	1519	3·76	1455	21
3·7	1427	3·7	1427	2·3	856	4·0	1565	3·70	1427	22
3·65	1404	3·62	1390	2·35	875	4·1	1615	3·70	1427	23
3·62	1390	3·58	1372	2·4	893	3·9	1519	3·70	1427	24
3·58	1372	3·4	1293	2·3	856	3·7	1427	3·60	1381	25
3·53	1349	3·34	1268	2·27	845	3·5	1335	3·50	1335	26
3·5	1335	3·12	1175	2·38	886	3·3	1251	3·45	1314	27
3·4	1293	3·0	1125	2·5	930	3·0	1125	3·40	1293	28
3·3	1251	2·8	1047	2·6	969	2·9	1086	3·31	1255	29
3·28	1243	2·67	996	2·85	1066	2·75	1028	3·15	1188	30
		2·6	969	2·8	1047			3·20	1209	31

The Pembina River.

A.—LOCATION AND DIRECTION.

The head-waters of the Pembina river are found on the northeasterly slopes of Turtle mountain, from which the river flows in a winding easterly direction. Fifty miles above its mouth the river bends southward, crossing the international boundary, then turning again to the east flows into the Red river about five miles south of Emerson.

B.—RIVER BASIN.

The basin of the river covers an area of 4,180 square miles, 1,440 of which are in Dakota; the balance, 2,740, in southern Manitoba.

In the upper reaches of the river basin there are located numerous small lakes and sloughs, and it is in this section that most of the drainage is obtained. One notable feature of the watershed is the fact that practically all of the drainage enters the river from the south, the tributaries entering from the north being small and having very little flow except in the early spring or times of excessive rains.

The principal tributaries are the Whitemud river, Long river, Beaver creek and Snowflake creek, all flowing from the south.

C.—BED AND BANKS.

The lower forty miles of the course of the river lie in flat level country, typical of the Red River valley. The banks of the stream cut sharply down from the level of the prairie to a depth of from twenty to forty feet. The conformation of the banks in this section is principally a sandy clay, which also constitutes the bed of the river.

After the above distance is traversed, the nature of the valley changes, the banks becoming bolder and rising to a height varying from 175 feet to 450 feet. The nature of the soil in the valley also changes, being much more sandy, and the flats and bed of the river are composed of sandy gravel and strewn with boulders.

D.—WIDTH.

The average width of the river is approximately ninety feet, but in the middle reaches it widens out in several places, forming lakes varying in width from half a mile to a mile and a half. The more important of these lakes are Swan lake and Rock lake, these being six and nine miles, long respectively

E.—TRANSPORTATION AND ACCESSIBILITY.

The Pembina river is not navigable, but, flowing through a well-settled country, it is easily accessible from good roadways, and also from railroads which cross it at many points in its winding course from mouth to head-waters.

F.—RUN-OFF.

(*a*) *Rainfall.*—The mean annual rainfall at the mouth of the river is 20 inches. This decreases as the course of the river is followed upwards, and at the head-waters the yearly average is 14 inches. This low rainfall has a decided effect on the flow, as it is in this locality that most of the drainage enters the river, and in times of drought the discharge is cut down to an extremely low figure.

(*b*) *Discharge Measurement.*—For some years the United States Geological Survey has made observations as to flow on the Pembina river at Neche, North Dakota, and from the report of these, *see* tables No. 38 to No. 42, it will be seen that there is a large variation in the flow of the river, the mean monthly discharge ranging from the

low flow of 3 second-feet during the months of August, September and October, in the year 1910, to a high flow of 3,870 in May of 1904.

F.—WATER-POWER.

There is no information at hand as to any surveys having been made on the river for the purpose of locating water-power sites, but the nature of the valley and the natural fall of the river point to the possibility of there being such in its course.

The fall of the river from the base of Turtle mountain to the point where the valley opens out into the valley of the Red river is 700 feet or approximately 3 feet per mile.

The low flow of the river is extremely small, and any power development depending on the natural flow would be subject to serious interference through lack of water for a considerable period of the year.

A certain amount of storage could be obtained on the lakes in the course of the river, and also on Pelican lake, which is about two miles distant from the river channel. Whether or not this storage would be sufficient to carry any development over the period of low flow is very uncertain.

TABLE No. 38.

MONTHLY DISCHARGE of Pembina River, at Neche, North Dakota, for 1903.

[Drainage area 2,940 square miles.]

Month.	DISCHARGE IN SECOND-FEET.			RUN-OFF
	Maximum.	Minimum.	Mean.	Total in Acre-feet.
April				
May			202	12,420
June	198	110	149	8,866
July	110	35	60	3,689
August			35	555
September				
October			42	1,749
November			42	1,156
December				
The period				

NOTE—Obtained from records of Water Resources Branch, U.S. Geological Survey.

TABLE No. 39.

Monthly Discharge of Pembina River, at Neche, North Dakota, for 1904.

[Drainage area 2,940 square miles.]

Month.	Discharge in Second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per Square Mile.	Depth in Inches on dr'n'ge area.	Total in Acre-feet.
April	3,580	217	1,920	0·653	0·56	87,600
May	3,870	1,420	2,640	·898	1·04	162,000
June	2,530	926	1,690	·575	·64	101,000
July	2,690	399	839	·285	·33	51,600
August	420	315	385	·131	·15	23,700
September	315	236	302	·103	·11	18,000
October	275	217	235	·080	·09	14,400
November	217	131	183	·062	·06	9,440
December						
The period						468,000

Note.—Obtained from records of Water Resources Branch, U.S. Geologicol Survey.

TABLE No. 39A.

Monthly Discharge of Pembina River, at Neche, North Dakota, for 1905.

[Drainage area 2,940 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on dr'n'ge area.	Total in acre-feet.
March 23-31	672	530	606	0·216	0·072	10,820
April	1,372	311	549	·196	·219	18,510
May	1,180	218	447	·160	·184	27,480
June	1,180	279	485	·173	·193	16,600
July	399	119	206	·074	·085	12,670
August	137	60	97	·035	·040	5,964
September	119	65	93.9	·034	·038	5,587
October	156	70	119	·042	048	7,317
November 1-26	137	91	116	·041	·040	5,982
The period						110,900

Note.—Obtained from records of Water Resources Branch, U.S. Geological Survey.

TABLE No. 40.

MONTHLY DISCHARGE of Pembina River, at Neche, North Dakota, for 1906.

[Drainage area 2,940 square miles.]

MONTH.	DISCHARGE IN SECOND-FEET.				RUN-OFF.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on dr'n'ge area.	Total in acre-feet.
April	1220	193	479	0·163	0·18	28,500
May	231	175	193	·066	·08	11,900
June	340	193	271	·092	·10	16,100
July	270	119	175	·060	·07	10,800
August	143	119	131	·045	·05	8,060
September	166	136	147	·050	·06	8,750
October	150	136	144	·049	·06	8,850
November	136	82	111	·038	·05	4,180
The period						97,100

NOTE.—Obtained from records of Water Resources Branch, U. S. Geological Survey.

TABLE No. 40A.

MONTHLY DISCHARGE of Pembina River, at Neche, North Dakota, for 1907.

[Drainage area. 2,940 square miles.]

MONTH.	DISCHARGE IN SECOND-FEET.				RUN-OFF.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on dr'n'ge area.	Total in acre-feet.
April 21-30			869	0·293	0·11	17,100
May	2,190	826	1600	·544	·63	98,400
June	805	263	507	·172	·19	30,200
July	272	76	156	·053	·06	9,590
August	80	36	54·3	·014	·02	3,340
September	47	23	34·8	·012	·01	2,070
October	66	36	55·2	·019	·02	3,390
November			38·0	·013	·01	2,260
December			19·0	·006	·01	1,170
The period						168,000

NOTE.—Obtained from records of Water Resources Branch, U.S. Geological Survey.

TABLE No. 40B.

MONTHLY DISCHARGE of Pembina River, at Neche, North Dakota, for 1908.

[Drainage area 2,940 square miles.]

MONTH.	DISCHARGE IN SECOND-FEET.				RUN OFF.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on dr'n'ge area.	Total in acre-feet.
January			6	·002	·002	369
February			3	·001	·001	173
March			3	·001	·001	184
April	927		375	128	·14	22,300
May	591	310	474	·161	·19	29,100
June	486	136	224	·076	·08	13,300
July	136	36	87·8	·030	·03	5,400
August	66	36	52·1	·018	·02	3,200
September	78	55	60·9	·021	·02	3,620
October 1–10	55	45	49·0	·017	·006	972
The year period						78,600

NOTE.—Obtained from records of Water Resources Branch, U.S. Geological Survey.

TABLE No. 41.

MONTHLY DISCHARGE of Pembina River, at Neche, North Dakota, for 1909.

[Drainage area 2,940 square miles.]

MONTH.	DISCHARGE IN SECOND-FEET.				RUN OFF.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on dr'n'ge area.	Total in Acre-feet.
June	654	268	427	0·145	0·07	11,000
July	164	73	113	·038	.04	5,600
August	100	22	48·3	·016	.02	2,970
September	32	22	27·7	·0094	.01	1,650
October	73	32	45·9	·016	.02	2,970
November	67	38	51·9	·018	.009	1,440

NOTE.—Obtained from records of Water Resources Branch, N.S. Geological Survey.

TABLE No. 42.

MONTHLY DISCHARGE of Pembina River, at Neche, North Dakota, for 1910.

[Drainage area, 2,940 square miles.]

MONTH.	DISCHARGE IN SECOND-FEET.				RUN OFF.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in Acre-feet.
March	685	115	349	0·118	0·08	11,800
April	250	147	166	·056	·06	9,880
May	164	86	120	·041	·05	7,380
June	100	7	60·4	·020	·02	3,590
July	100	10	34·9	·012	·01	2,150
August	10	3	6·87	·0023	·003	422
September	7	3	3·93	·0013	·001	234
October	10	3	6·39	·0022	·003	393

NOTE.—Obtained from records of Water Resources Branch, U.S. Geological Survey.

THE SOURIS RIVER.

A.—LOCATION AND DIRECTION.

The source of the Souris river lies in the southern part of the province of Saskatchewan, its head-waters being about 20 miles northwest of the town of Weyburn.

The upper course of the river is in a southeasterly direction, down into the state of North Dakota, where it bends to the northeast, and this general course is followed until it joins the Assiniboine river, about 22 miles southeast of the city of Brandon.

B. RIVER BASIN.

The basin of the Souris is probably larger in comparison with its flow than any other western river, it covering an area of 22,860 square miles. The extreme width of same is 160 miles and the length from head-waters to mouth 200 miles.

The length of the river itself, considering its windings, is nearly 550 miles, with a width varying from 85 to 170 feet.

The upper part of the basin in Manitoba consists, in the greater part, of a sandy or gravely substratum, overlaid with a light alluvial soil. The valley in this district is shallow but, as it nears the mouth of the river, the soil becomes heavier and the valley much bolder, with steep banks rising to a height of 150 to 200 feet in some localities. The banks of the stream itself vary from 20 to 30 feet in height, and consist of sand, gravel and clay. The land above the banks of the valley is, as a rule, bald prairie with very little timber showing, all of which is small and in isolated clumps.

C.—HIGH AND LOW WATER.

The difference between high and low water of the river in some districts has been noted as being 20 feet, but this is an extreme condition, the normal variations being about 10 or 12 feet.

D.—SETTLEMENTS.

Throughout the basin of the river in Manitoba, the country is well settled, and several thriving towns are noted along the course of the river itself, among them being Wawanesa, Souris, Hartney and Melita.

E.—TRANSPORTATION AND ACCESSIBALITY.

The river is not navigable except by row-boat or canoe, and difficulty would be experienced in travelling even by them in the low stages.

Passing through a well-settled country with a soil which tends to be of rather a sandy nature, the roads are good and the river easily accessible therefrom at many points. It is also in close touch with railroads throughout its entire length. From the town of Souris, the Estevan branch of the C.P.R. closely follows the course of the river to within a short distance of the point at which it flows across the international boundary from the state of North Dakota.

F.—RUN-OFF.

(*a*) *Rainfall.*—The precipitation over the area drained by the Souris is very small, being from 15 to 18 inches, and the actual run-off for the year ending October 31, 1913, was found to be 1·4 inches per square mile of drainage area.

This extremely small run-off from the large area drained may be attributed to: First, small rainfall and snowfall; second the topography of the country; the flat prairie country through which the river runs holds the water in the sloughs where it evaporates rapidly, aided by the winds which have full play across the open stretches; third, the distribution of the rainfall. It is noticed from meteorological reports that the greatest amount of rainfall in this area comes in the growing season of the year, when evaporation losses are also greatest.

(*b*) *Discharge Measurements.*—In October of the year 1912, a metering station was established on the river at the town of Wawanesa, by the Manitoba Hydrographic Survey, and during the winter of 1912-13, and the spring and summer of the present year, eight discharge measurements have been made, the results of which are shown in table No. 43.

Daily gauge height records have been kept at this station and these with their estimated discharges are shown in tables No. 44 and No. 45.

G.—WATER-POWER.

The difference in elevation between the water levels where the river joins the Assiniboine and the point where it first enters the province is 305 feet, or about 2 feet per mile.

There has been no survey work done on this river for the purpose of locating possible power sites, and the estimate of power obtainable as shown in table below is per foot of head.

This table is based on the estimated minimum flow for the year ending October 31, 1913, and also on the lowest mean monthly flow for a period of six months from May to October of the same year. These figures apply only to the periods above stated.

Head in feet.	Estimated horse-power at 80 per cent efficiency.	
	Minimum flow 5 sec.-ft.	Flow 50 sec.-ft. Period May to October.
1	·45	4·5
10	4·5	45
20	9	90

TABLE No. 43.

Discharge Measurements of Souris River, near Wawanesa, 1912-13.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean Velocity.	Gauge height.	Discharge.
1912			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
Oct. 7	W. G. Worden..	1496	85·0	169·2	·53	1·50	89·6
Oct. 26	G. Lamb.. ...	1186	86·0	162·3	·55	1·49	89·3
1913.							
Jan. 29	G. Lamb.	1374	21·5	19·5	·38	1·93	7·5
Apr. 15	E. Bankson	1469	94·2	436·8	2·51	4·25	1087·7
May 7	E. Bankson	1469	96·2	462·8	3·01	4·82	1434·1
June 30	A. Pirie.....	1496	86·0	156·4	·56	1·49	89·0
Aug. 11	W. J. Ireland...	1469	85·0	129·3	·32	1·20	41·6
Sept. 10.	W. J. Ireland...	1469	85·0	131·0	·35	1·27	46·1

(1) Ice measurements.

TABLE No. 44.

Daily Gauge Height and Discharge, Souris River, near Wawanesa, for 1912.

Day.	October.		November.		Day.	October.		November.	
	Gauge height.	Discharge.	Gauge height.	Discharge.		Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.		Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·44	77	17	·50	84	·61	
2			·53	88	18	49	83	50	
3			·50	84	19	51	85	·56	
4			·56	92	20	49	82	54	
5			44	77	21	1·48	82	1·52	
6			1·40	72	22	49	83	64	
7	1·50	84	·41	73	23	48	82	·75	
8	·50	84	42	74	24	·46	79	62	
9	·52	87	39	71	25	49	83	36	
10	·52	87	·43	76	26	1·49	83	1·66	
11	1·50	84	1·45	78	27	47	80	55	
12	·50	84	·45	78	28	47	80	63	
13	·50	84	·43	76	29	·48	82	63	
14	51	85	·42	74	30	49	83	63	
15	·53	88	·41	73	31	·46	79		
16	1·49	83	1·77						

TABLE

Daily Gauge Height and Discharge,

Days.	January.		February.		March.		April.		May.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·97		2·08				4·89	1,435
2									·90	1,440
3									·91	1,445
4	1·81								·86	1,420
5									·83	1,405
6									4·83	1,405
7									·82	1,400
8			1·63		2·08				·80	1,390
9									·78	1,380
10									·73	1,355
11	1·62								4·67	1,325
12									·59	1,285
13									·52	1,250
14									·43	1,205
15			1·50		3·22		4·24	1,110	·29	1,135
16							4·24	1,110	4·06	1,020
17							·35	1,165	3·85	915
18	2·07						·48	1,230	·66	820
19							·61	1,295	·48	730
20							·67	1,325	·25	615
21							4·74	1,360	3·05	515
22			2·23		3·61		·78	1,380	2·94	463
23							·83	1,405	·86	429
24							·84	1,410	·81	409
25							·87	1,425	·75	385
26							4·87	1,425	2·69	361
27							·86	1,420	·59	327
28							·83	1,405	·59	327
29	1·93	7·5			3·33		·83	1,405	·54	312
30							·83	1,405	·45	285
31									·38	264

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No. 45.

Souris River, near Wawanesa, for 1913.

June.		July.		August.		September.		October.		
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Day.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
2·29	237	.....	78	1·19	47	1·24	53	1·25	54	1
·22	220	1·42	74	·19	47	·22	50	·25	54	2
·18	210	·41	73	·18	46	·24	53	·26	55	3
·07	183	·40	72	·18	46	·25	54	·25	54	4
·17	207	·38	67	·17	45	·25	54	·20	48	5
2·12	195	1·34	65	1·17	45	1·28	57	1·18	46	6
·02	172	·34	65	·19	47	·27	56	·17	45	7
1·99	166	·30	60	·17	45	·27	56	·20	48	8
·96	160	·29	59	·17	45	·24	53	·21	49	9
·94	156	·30	60	·19	47	·27	56	·28	57	10
1·87	142	1·34	65	1·20	48	1·27	56	1·27	56	11
·85	139	·36	67	·20	48	·28	57	·27	56	12
·82	133	·37	68	·20	48	27	56	·30	60	13
·82	133	·40	72	·20	48	·25	54	·28	57	14
·82	133	35	66	·26	55	·25	54	·25	54	15
1·81	132	1·35	66	1·19	47	1·25	54	1·22	50	16
·75	122	·34	65	·27	56	·26	54	·26	55	17
·69	112	·29	59	·26	55	·26	55	·24	53	18
·68	110	·27	56	·33	64	28	57	·23	52	19
63	102	·25	54	·26	55	31	61	22	50	20
1·57	93	1·24	53	1·38	70	1·27	56	1·15	43	21
·50	84	·23	52	·38	70	·22	50	·20	48	22
·49	83	·22	50	·35	66	·27	56	·22	50	23
·48	82	·21	49	·35	66	·32	62	·23	52	24
44	77	·22	50	·34	65	·31	61	·24	53	25
1·41	73	1·20	48	1·34	65	1·22	50	1·22	50	26
41	73	·19	47	·33	64	·28	57	·23	52	27
55	91	·18	46	29	59	·26	55	·15	43	28
55	91	·18	46	·26	55	·26	55	·18	39	39
49	83	·18	46	·26	55	·26	55	·18	39	30
. .	. .	18	46	·26	55	.....	.....	19	39	31

Shell River.

A.—Location.

The Shell river, one of the largest tributaries of the Assiniboine, has its source in the northerly part of Duck mountain, and flowing from the same, empties into the Assiniboine about three miles above the village of Shellmouth.

B.—Direction.

The general direction of the river is almost due south from its source; crossing and re-crossing the dividing line between ranges 27 and 28 west of the first meridian to a point within five miles of its mouth, where it bends sharply to the west and joins the Assiniboine from a southeasterly direction.

C.—River Basin.

The watershed near the mouth of the river is narrow, being confined between the watersheds of the Valley river and the Assiniboine; but as it nears the upper reaches, it broadens out to approximately 35 miles in width, where it adjoins the watershed of the Swan river. It is in this upper section that most of its drainage is obtained, though throughout the entire length of the river it is continually fed by springs and short streams, common in the river flowing in so well-defined a valley, of a gravelly

formation, as that of the Shell. The largest tributary entering the river is met with about 70 miles from its mouth, and is known as the East Branch Shell river.

The length of the basin from north to south is approximately 60 miles, while the river itself, taking into account its widenings, has a length of 90 miles.

D.—NATURE OF BANKS.

The valley of the Shell is one of the most beautiful to be met with in connection with any of the smaller rivers of the province, varying in depth from 100 feet, near the head-waters, to 350 feet, when within about four miles of its mouth, and with an average width of three-quarters of a mile.

The banks are mostly of a gravelly nature, strewn with boulders and overgrown with scrub and small poplar. While on the plateaus on either side is to be found agricultural land which will compare very favourably with the best to be found in the province.

E.—WIDTH OF RIVER AND NATURE OF BOTTOM.

The natural bed of the river varies between 50 and 90 feet in width, and is stated as being of a gravelly nature throughout, and strewn with large boulders.

Throughout the length of the river there are to be found no distinct falls, but numerous rapids are met with where the valley has narrowed and the bed of the river is contracted.

F.—TIMBER AND VEGETATION.

The upper waters of the river flow through the Duck Mountain Forest reserve, and in this district valuable timber is to be found. As the course is followed southward, it is stated that the timber has been burnt over and scrub and light poplar covers the unbroken land, while low in the valley there is considerable spruce and tamarack.

On reaching the flats at the junction of the Shell and Assiniboine, some splendid groves of large elms are encountered.

For some years a small saw-mill was operated at the village of Asessipi, but for the last fifteen years no lumbering operations have been carried on, on this river.

G.—HIGH AND LOW WATER.

At the point where observations for high and low water are made, it was found that there is a variation of about four feet between high water, which usually occurs during the months of May and June, and low water, as a rule during the month of September. It was learned from local inquiry that the river is not subject to sudden changes or to excessive floods, its rise and fall being mostly steady and gradual.

II.—TRANSPORTATION.

On account of the depth and the numerous rapids, the only means of navigating the river itself would be by canoe. There are various points in its length where it is crossed by trails and, for a considerable distance in the middle length of the river, trails follow closely the course of same.

The C. N. R., Edmonton branch crosses the river at the town of Shevlin, while the closest railroad station in the vicinity of the mouth of the river is on the C.N.R. at Shellmouth.

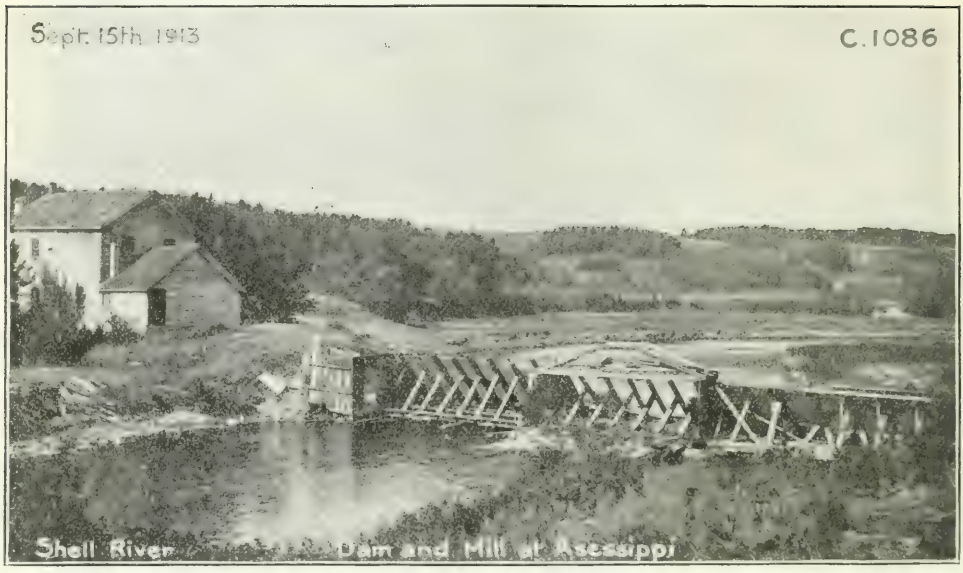
I.—SETTLEMENTS.

Although in the southerly section of the river basin the land is well settled, there are only two small villages on the river itself, one at Asessipi, about four miles from the mouth, and the other at Shevlin, twenty-five miles upstream.

The village of Asessipi is comprised of possibly fifty people, there being located there a store, a school, a church and an old flour and grist mill. This mill has been operated by water power from the year 1884 up to the spring of 1911, when it was put

250—T

Sept. 15th 1916
C. 1083
Shell River
Traffic Bridge at Aspelippi


Sept. 15th. 1913
C.1086
Shell River Dam and Mill at Assessippi

Sept. 15th. 1913
C.1082
Town of Assessippi. Shell River Valley

out of commission through the breaking away of the dam from which it obtained its power. The dam is at present being repaired, and it is expected that it will be in operation during the coming winter.

The town of Russell is located fourteen miles directly south of Asessipi, and a splendid well-settled farming country lies between the two.

J.—RUN-OFF.

(*a*) *Rainfall.*—The precipitation records covering a period of nine years, taken at Russell, located at the south of the drainage area of the river, give a mean yearly rainfall of 16·4 inches. Records taken at Swan river at the north of the drainage area and covering a period of four years, give a mean yearly rainfall of 20·8 inches. The above records would give approximately a mean yearly precipitation for the river basin of 18 inches. Assuming 25 per cent of this as actual run-off, we have a mean yearly discharge of 288 second-feet, or 0·33 second-feet per square mile of drainage area.

(*b*) *Discharge measurements.*—A regular gauging station was established on the river during November of the present year, by the Manitoba Hydrographic Survey. Field work in connection with this station is being carried on, but as yet sufficient data have not been collected on which to base a definite estimate of flow.

The result of a discharge measurement made by this survey, September 15, 1913, will be found in table No. 46. This measurement was made when, acording to local authority, the stage of the river approached very nearly the ordinary low-water level for the year.

K.—WATER-POWER POSSIBILITIES.

As to the locations for possible power developments, there is very slight information, there having been no survey work done on the river with this object in view, but from casual observance and the information at hand, it seems as if this river is to be rated as one of the best for power purposes among the smaller rivers of the province.

From the mouth of the river to the junction of the East Branch Shell river, approximately 75 miles, there is a difference in elevation of 600 feet, or 8 feet to the mile. This fall is quite evenly distributed in the upper reaches, but the percentage of drop increases in the lower section of the river. This natural drop, combined with the accompanying high banks, practically throughout the course of the river, point to easy development at different points along its course.

The one development on the river at Asessipi has a head of 10 feet, and though using only a small portion of the flow, developed 50 horse-power, and never at any time of the year was there experienced trouble through lack of flow.

There having been no survey made on the river locating possible dam sites, the information as to actual head at any such is not available, but the following table gives the possible horse-power per foot head, with an assumed minimum monthly flow. This assumed flow is taken as extending over a period of six months, from May to October, and is subject to revision.

In the table (*a*) is the head in feet, (*b*) is the assumed minimum flow in second-feet during the six open months of the year, (*c*) is the available horse-power at 80 per cent efficiency.

(*a*)	(*b*)	(*c*)
1	200	18·2
10	200	182·0
20	200	364·0

In regard to winter flow on the river, sufficient data are not at hand on which to base an estimate, as there have been no winter observations made, but the above figures for the open months would possibly be reduced 60 per cent during the remaining six months of the year.

TABLE No. 46.

DISCHARGE MEASUREMENTS of Shell River at Asessipi, 1913.

Date.	Hydrogropher.	Meter No.	Width.	Area of sections.	Mean velocity.	Gauge height.	Discharge
1913.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Sept. 15 ...	W. J. Ireland...	1169	83·0	93	2·3	No gauge.	213·5

THE ASSINIBOINE RIVER.

The Assiniboine river has its source in the province of Saskatchewan in the south-easterly slopes of Nut mountain adjacent to the head-waters of the Red Deer river. From here the river flows in a southwesterly direction until it crosses the boundary between Saskatchewan and Manitoba, where it bends southward and follows this direction until approximately in the latitude of Brandon where it assumes an easterly bearing, and this general direction is followed to a point where it joins the Red river in the city of Winnipeg.

B.—RIVER BASIN.

The total drainage basin of the Assiniboine covers an area of 59,550 square miles. Of this area approximately 8,800 square miles lie in the state of North Dakota, 37,-700 miles in the province of Saskatchewan, and 13,050 miles in the province of Manitoba.

The principal tributaries of the river are the Quapelle, the Souris, the Shell, and the Little Saskatchewan.

The drainage entering the river in the lower hundred miles of its course is very slight, as the basin is confined between the watersheds of the Red river and lake Manitoba.

Above the city of Brandon a large increase of the incoming drainage is noticed, and in its upper course the river is continually fed by springs, and streams draining the numerous small lakes with which the upper basin is dotted.

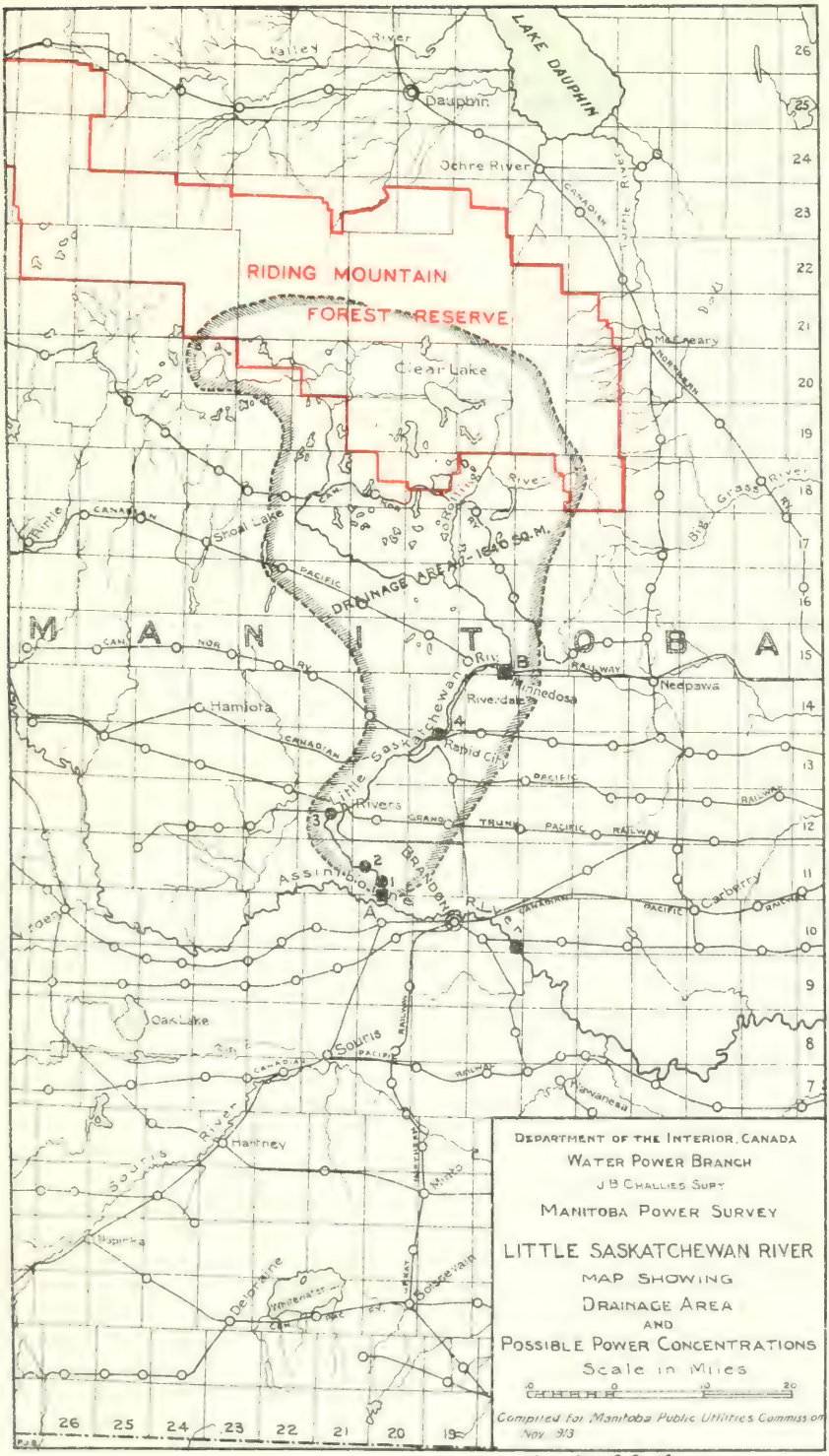
C.—DESCRIPTION OF BANKS.

At the point where the river crosses the dividing line between Manitoba and Saskatchewan, the river flows in a narrow valley, with the banks rising sharply to a height of two hundred and fifty feet on the east side, and with a more gradual rise on the west to approximately the same elevation.

The high banks of the valley seem to be characteristic of the river until it has reached a point considerably below the junction of the Souris river. From this point to the mouth the river flows through level prairie land, with sharply cut banks rising directly from the water's edge to a height varying from three or four feet to twenty-five feet.

There is noted a great variation in the width of the valley, which, in a number of districts, spreads sufficiently to allow the carrying on of extensive farming operations on the flats which lie on either side of the river. The soil of these flats, though being of a very rich nature, is in constant danger of flood in the spring freshets.

PLATE 12



DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
J B CHALLIES SUPT.

MANITOBA POWER SURVEY

LITTLE SASKATCHEWAN RIVER

MAP SHOWING
DRAINAGE AREA
AND
POSSIBLE POWER CONCENTRATIONS

Scale in Miles

0 10 0 10 20

Compiled for Manitoba Public Utilities Commission
Nov. 9/3

Douglas L. McLean, Chief Engineer
Stuart S. Stacey, Asst. Chief Engineer

D.—WIDTH AND BED OF RIVER.

The approximate width of the river where it enters the province is one hundred and fifty feet, and in its course it varies between this width and two hundred and fifty feet.

The bed of the river in the upper reaches is mostly of a sandy or gravelly nature, mixed with large boulders, but as it nears the outlet the banks and bed are composed largely of a sandy clay and boulders, with an underlying stratum of blue clay at a depth of from five to ten feet.

E.—TIMBER AND VEGETATION.

Throughout the basin of the river in Manitoba the land is practically all settled and being worked for agricultural purposes. There is very little standing timber of any value to be found on same. What is met with is mostly small and of little value except for firewood.

F.—SETTLEMENTS.

Th Assiniboine flows through the mostly thickly-settled section of the province and on its banks are found three of the largest cities in the province, namely, Winnipeg, Portage La Prairie and Brandon, while its point of junction with the Red river is directly opposite the city of St. Boniface.

G.—TRANSPORTATION AND ACCESSIBILITY.

In the lower reaches the river can be navigated with boats of small draft but, on account of its very winding nature and the numerous shoals, the river is not used for navigation of a commercial nature or for purposes other than pleasure. At almost any point in its length in Manitoba the river is easily accessible from good roads and prairie trails. It is crossed by numerous lines of railroads, and its course is closely paralelled by them for a large percentage of its length throughout the province.

H.—RUN-OFF.

(*a*) *Rainfall.*—From the records of the metereological stations scattered throughout the basin of the river, we find that the average annual precipitation for the drainage area is approximately seventeen inches.

(*b*) *Discharge measurements.*—A gauging station was established on the river at the St. James C.P.R. bridge in May of the year 1912, by the Manitoba Hydrographic Survey. At this station sixteen discharge measurements were taken during a year's observations. The results of these measurements are shown in table No. 55. This station was abandoned in the spring of the present year to escape the possibility of backwater effects from the closing of the dam at the St. Andrew's locks. There are at present three gauging stations located on the river, which were established by the Manitoba Hydrographic Survey. The first of these, established in the spring of 1913, is located at the C.P.R. bridge at Headingly, fourteen miles west of the city of Winnipeg. Since the installation of this station there have been fourteen discharge measurements made, the result of which are shown in table No. 53. Daily gauge readings have also been made and a record of these, with the estimated daily discharges, will be found in table No. 54.

The second station is located in the city of Brandon at the First street traffic bridge. It was established in July of 1912, and since that time continuous observations have been carried on. A record of the discharge measurements made during that time will be found on tables No. 49 and No. 50, and the daily gauge heights with their estimated daily discharges are recorded in tables No. 51 and No. 52.

The third station, located at the village of Millwood, was established in October of 1912, on the traffic bridge below the old dam and, during the year, eight discharge measurements were taken, the results of which are shown in table No. 47. The daily gauge height records, with estimated daily discharges, are given in table No. 48.

I.—HIGH AND LOW FLOW.

The river, during the spring freshets, is liable to large variations in stage, and during the present year a variation of twelve feet has been noted between the extreme high and low-water level. The period of high water, however, does not cover more than three weeks, and the average variation during the remainder of the year is approximately five feet.

J.—POWER DEVELOPMENTS.

There are at present no power developments on the river in the province of Manitoba, the one previous development having been destroyed in the spring flood of this year. This development was located at the village of Millwood, where a total head of eighteen feet was obtained. The power developed was for the purpose of operating a flour mill, but it has not been used to any great extent in late years. A timber dam was built across the river, and a large part of this still remains in fairly good condition, but the foundations of the mill itself were destroyed by the scouring action of the water and, the building being mostly of timber construction, was carried down the river. Photographs of this location in its present condition are shown on page 113.

K.—POWER SURVEYS.

There have been three surveys made on the river in the vicinity of the city of Brandon with a view of locating possible dam sites for the development of power for the city, one of these being made in 1902 by the late Cecil B. Smith for the Western Electric Light and Power Company. The second, by R. E. Speakman, city engineer of the city of Brandon. This survey was made at the instance of Mr. Speakman for the purpose of investigating a proposition made to the city by the above-mentioned power company. During the early summer of the present year a reconnaissance survey was made by the Manitoba Power Survey under the direction of the late G. H. Burnham, at a point about twelve miles below Brandon.

The results of these surveys show that in the vicinity of Currie's Landing (see plate No. 13), twelve miles below the city of Brandon, there is a possible head of eighteen feet obtainable. This head would probably be diminished somewhat during times of high water.

L.—WATER-POWER.

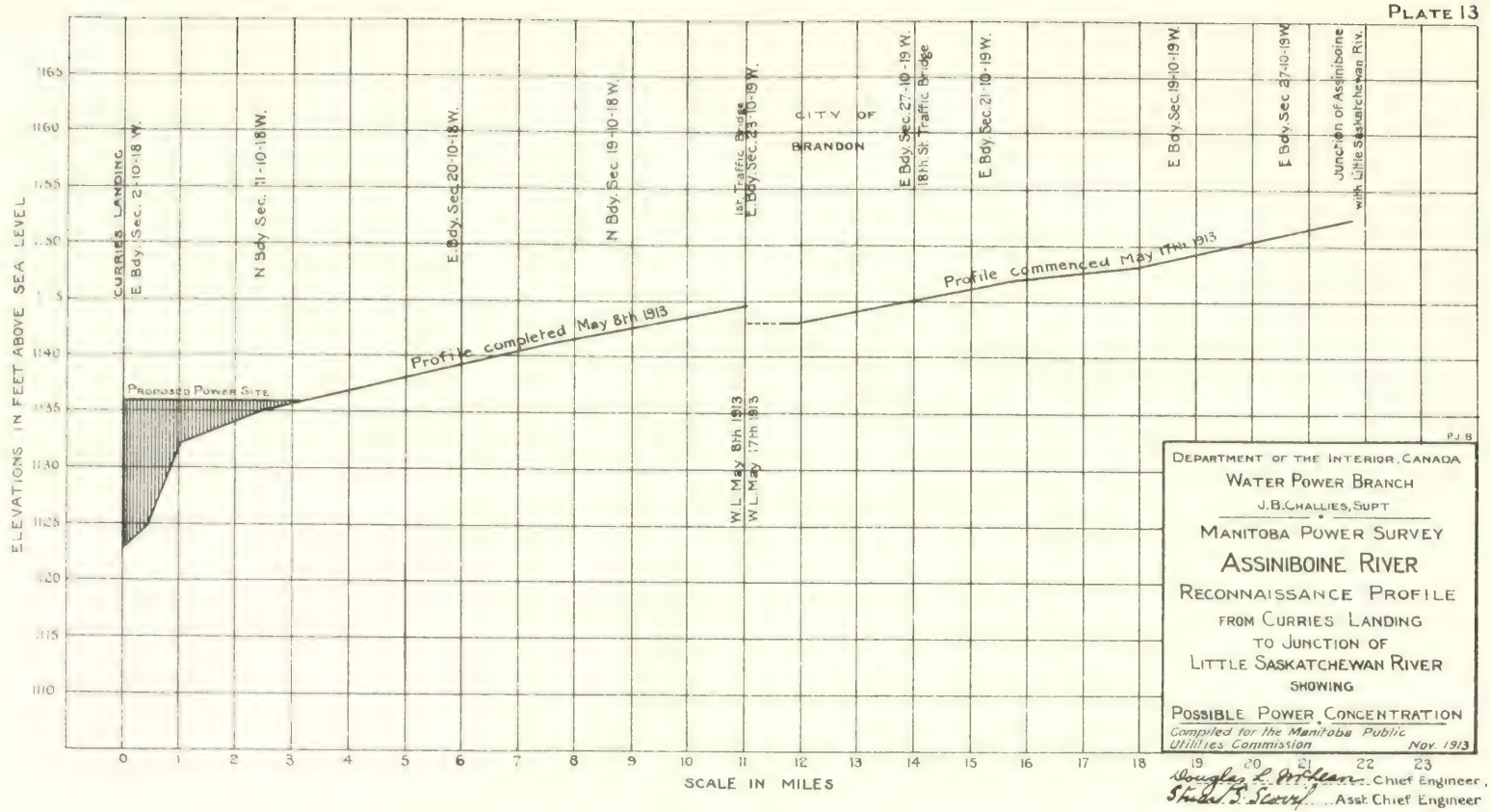
Based on the estimated flow at the three metering stations above noted, for the year ending October 31, 1913, the following tables give the power available per feet at an 80 per cent efficiency, and for the estimated low flow at each station, and also for the lowest monthly mean flow for a period of six months, from May to October. In this latter case the estimated power only relates to the period as stated above.

These tables would apply to any proposed development on the river in the neighbourhood of the stations at which the information was obtained, and also at the Currie's Landing dam site.

HEADINGLY.

Head in feet.	Estimated Horse-power at 80 per cent Efficiency.	
	Minimum flow 400 sec.-ft.	Flow 1182 sec.-ft. Period May to Oct.
1	36·3	107·5
10	363	1075
20	726	2150

PLATE 13



DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
J. B. CHALLIES, SUPT

MANITOBA POWER SURVEY

ASSINIBOINE RIVER

RECONNAISSANCE PROFILE
FROM CURRIES LANDING
TO JUNCTION OF
LITTLE SASKATCHEWAN RIVER
SHOWING
POSSIBLE POWER CONCENTRATION

Compiled for the Manitoba Public Utilities Commission Nov. 1913

Douglas C. McLean, Chief Engineer,
Thos. B. Scott, Asst. Chief Engineer

BRANDON.

Head in feet.	ESTIMATED HORSE-POWER AT 80 PER CENT EFFICIENCY.	
	Minimum flow 400 sec.-ft.	Flow 1030 sec.-ft. Period May to Oct.
1	36·3	93·6
10	363	936
20	726	1872

MILLWOOD.

Head in feet.	ESTIMATED HORSE-POWER AT 80 PER CENT EFFICIENCY.	
	Minimum flow 160 sec.-ft.	Flow 705 sec.-ft. Period May to Oct.
1	14·5	64·0
10	145	640
20	290	1280

CURRIE'S LANDING DAM SITE.

Head in feet.	ESTIMATED HORSE-POWER AT 80 PER CENT EFFICIENCY.	
	Minimum flow 400 sec.-ft.	Flow 1030 sec.-ft. Period May to Oct.
18	653	1685

TABLE No. 47.

DISCHARGE MEASUREMENTS of Assiniboine River, near Millwood, 1913.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.
1912.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Oct. 11	Worden	1497	145	881·2	1·85	2·29	1628
1913.							
Jan. 27	G. Lamb	1374	146	254·4	0·68	·48	174[1]
April 19	E. Bankson	1469	157·5	1484·4	3·08	6·45	4571
May 9	" "	1469	192	1704·8	3·08	7·42	5253
July 3	A. Pirie	1496	145	740	1·82	1·65	1346
Aug. 6	W. J. Ireland	1469	168·8	1469·8	2·58	5·65	3789
Sept. 13	" " "	1469	144	699·7	1·72	1·30	1201
Oct. 19	C. O. Allen	1435	144·5	536·5	0·31	0·31	632

(1) Ice measurement.

TABLE

Daily Gauge Height and Discharge of

Day.	January.		February.		March.		April.		May.	
	Gauge height.	Dis. charge.	Gauge height.	Dis-charge.	Gauge height.	Dis-charge.	Gauge height.	Dis-charge.	Gauge height.	Dis-charge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1										6,351
2			0·40		0·80				8·25	6,183
3									7·80	5,720
4									8·20	6,130
5									7·70	5,625
6							1·50	1,260	7·50	5,435
7									7·20	5,150
8									6·80	4,780
9			0·20		0·80				7·40	5,340
10									7·20	5,150
11									7·10	5,055
12									7·00	4,960
13							7·50	5,435	6·80	4,780
14							6·83	4,807	·60	4,600
15							·50	4,515	·50	4,515
16			0·40		0·90		6·50	4,515	6·40	4,430
17							·58	4,583	·20	4,270
18							·42	4,447	·00	4,110
19							·50	4,515	5·90	4,035
20							·83	4,807	·80	3,960
21							7·83	5,748	5·70	3,885
22									·60	3,810
23			0·30		0·80				·50	3,735
24									·40	3,660
25									·40	3,660
26	0·48								5·30	3,558
27									·20	3,515
28									·20	3,515
29									·10	3,445
30					1·00				·00	3,375
31									·90	3,305

SESSIONAL PAPER No. 25e

No. 48.

Assiniboine River, near Traffic Bridge, Millwood, for 1913.

June.		July.		August.		September.		October.		
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Day.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
4·80	3,235	1·40	1,210	5·60	3,810	2·17	1,609	0·34	746	1
70	3,165	·50	1,260	·65	3,848	·07	1,554	·31	734	2
·50	3,035	·68	1,350	·70	3,885	·00	1,515	·29	726	3
·40	2,970	2·40	1,735	·70	3,885	1·96	1,493	·26	706	4
40	2,970	3·00	2,085	·73	3,908	93	1,477	·23	702	5
4·20	2,840	3·80	2,580	5·70	3,885	1·87	1,445	0·20	690	6
·00	2,710	4·30	2,905	·60	3,810	·79	1,405	·19	686	7
3·70	2,515	·55	3,068	·50	3,735	·73	1,375	·18	682	8
·40	2,325	·68	3,152	·20	3,515	·66	1,340	·18	682	9
·20	2,205	·80	3,235	4·70	3,165	·55	1,285	·23	702	10
3·00	2,085	5·00	3,375	4·00	2,710	1·46	1,240	0·26	714	11
2·70	1,905	·57	3,788	3·40	2,325	·36	1,190	·29	726	12
·70	1,905	·65	3,848	·05	2,115	·26	1,142	·29	726	13
·50	1,790	·80	3,960	2·76	1,905	·18	1,106	·29	726	14
·20	1,625	·83	3,983	·40	1,735	·10	1,070	·30	730	15
2·10	1,570	5·88	4,020	2·40	1,735	1·01	1,030	0·30	730	16
·00	1,515	·92	4,050	.....	1,780	0·91	985	·32	738	17
1·90	1,460	·90	4,035	.....	1,840	·85	958	·32	738	18
·70	1,360	·85	3,998	.....	1,890	·80	935	·30	730	19
·60	1,310	·88	4,020	.....	1,940	·73	904	·28	722	20
1·50	1,260	5·90	4,035	.....	2,000	·68	853	0·29	726	21
·40	1,210	·95	4,073	2·86	2,001	0·61	854	·14	666	22
·30	1,160	·93	4,058	·94	2,049	·56	834	·70	890	23
·30	1,160	·85	3,998	·99	2,079	·54	826	·12	658	24
·20	1,115	·80	3,960	·92	2,037	·50	810	·25	710	25
1·10	1,070	5·75	3,923	2·79	1,959	0·49	806	0·29	726	26
·00	1,025	·70	3,885	2·77	1,947	·46	794	·20	690	27
·00	1,025	·60	3,810	·67	1,887	·42	778	·04	595	28
·10	1,070	·60	3,810	·51	1,796	·40	770	·23	535	29
·30	1,160	·60	3,810	·39	1,730	·37	758	·18	682	30
.....	.....	·60	3,810	·26	1,658	.....	.....	·05	632	31

TABLE No. 49.

DISCHARGE MEASUREMENTS of Assiniboine River, at Brandon, 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
July 4	G. H. Burnham	1187	216·5	985·7	2 74	3·79	2701
July 6	"	1187	214·5	889·3	2·72	3·53	2419
July 20	"	1187	216	870·2	2·72	3·31	2367
July 22	"	1187	215·5	857·2	2·62	3·15	2246
Aug. 10	W. G. Worden	1187	207·1	791·1	2·59	2·99	2049
Aug. 23	A. Pirie	1197	190·5	738·0	2·03	2·19	1489
Oct. 5	W. G. Worden	1497	233·5	1504·5	3·16	6·28	4745
Oct. 25	G. Lamb	1187	215·5	950·5	2·77	3·87	2633

TABLE No. 50.

DISCHARGE MEASUREMENTS of Assiniboine River, at Brandon, 1913.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Jan. 22	G. Lamb	1375	148	238·5	1·62	1·95	387[1]
Feb. 20	A. Pirie	1469	167	277·0	1·37	1·95	380[1]
April 7	E. Bankson	1469	262	2099·7	3·77	8·54	7578
May 6	"	1469	348	3327·6	3·87	12·37	12869
June 23	A. Pirie	1496	205	826·6	2·48	3·21	2048
Aug. 9	W. J. Ireland	1469	243·1	1516·7	2·93	5·69	4442
Sept. 9	"	1469	214·2	756·9	2·44	2·77	1833
Oct. 20	"	1469	183·3	505·8	1·74	1·47	880

[1] Ice measurement.

TABLE No. 51.

DAILY GAUGE HEIGHT AND DISCHARGE, Assiniboine River, near Brandon, for 1912.

Day.	JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft
1	.....	....	3·03	2046	2·21	1472	6·58	5223	3·46	2365
2	.. ....	.....	3·08	2081	2·26	1507	6·52	5157	3·40	2320
3	.....	.....	3·07	2074	2·30	1535	6·47	5102	3·32	2360
4	3·65	2510	2·99	2018	2·27	1514	6·35	4970	3·25	2208
5	3·55	2433	3·05	2060	2·29	1528	6·26	4873	3·21	2178
6	3·48	2380	3·08	2081	2·32	1549	6·19	4800	3·18	2155
7	3·01	2032	3·00	2025	2·48	1661	5·95	4548	3·15	2133
8	3·09	2088	2·91	1962	2·77	1864	5·82	4415	3·12	2110
9	2·71	1822	3·00	2025	2·95	1990	5·68	4275	3·08	2081
10	2·76	1857	2·98	2011	3·21	2178	5·50	4100	3·05	2060
11	2·83	1906	2·91	1962	3·40	2320	5·33	3939	3·02	2039
12	2·89	1948	2·91	1962	3·72	2566	5·13	3757	3·00	2025
13	2·87	1934	2·91	1962	3·93	2734	4·95	3595	2·96	1997
14	2·81	1892	2·79	1878	4·60	3290	4·80	3460	2·92	1969
15	2·92	1969	2·53	1696	4·73	3401	4·67	3350	2·89	1948
16	3·03	2046	2·59	1738	4·78	3443	4·55	3248	2·87	1934
17	3·22	2185	2·42	1619	4·80	3460	4·43	3146	2·40	1605
18	3·40	2320	2·31	1542	4·78	3443	4·35	3078	2·40	1605
19	3·13	2118	2·30	1535	4·79	3452	4·27	3010	2·40	1605
20	3·13	2118	2·33	1556	4·79	3452	4·18	2934	2·39	1598
21	3·20	2170	2·23	1486	4·97	3613	4·10	2870	2·39	1598
22	3·14	2125	2·15	1433	5·46	4062	3·98	2774	2·26	1507
23	3·04	2053	2·10	1400	5·51	4110	3·92	2726	2·14	1426
24	2·95	1990	2·05	1368	5·59	4186	3·88	2694	2·14	1426
25	2·90	1955	2·23	1486	5·68	4275	3·87	2686	2·60	1745
26	2·71	1822	2·03	1355	5·71	4305	3·80	2630		
27	2·90	1955	2·00	1335	5·89	4485	3·73	2574		
28	2·81	1892	1·90	1270	6·00	4600	3·68	2534		
29	3·02	2039	2·20	1465	6·27	4884	3·62	2486		
30	3·01	2032	1·93	1290	6·44	5069	3·57	2448		
31	2·99	2018	1·97	1316	....	... .	3·53	2410		

TABLE No. 52.

Daily Gauge Height and Discharge, Assiniboine River, at Brandon, 1913.

Day.	April.		May.		June.		July.		August.		September.		October.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec. ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	...	...	13·82	14837	6·65	5303	3·20	2140	5·95	4548	3·43	2343	1·62	1088
2	...	...	13·82	14837	6·57	5212	3·11	2103	5·90	4495	3·30	2245	1·58	1062
3	...	...	...	...	6·40	5025	3·13	2118	5·86	4455	3·22	2185	1·55	1043
4	...	...	...	...	6·23	4842	3·27	2223	5·85	4445	3·17	2148	1·50	1010
5	...	...	...	...	6·09	4695	3·45	2358	5·85	4445	2·80	1885	1·52	1023
6	...	...	12·37	12880	6·00	4600	3·65	2510	5·84	4435	3·02	2039	1·67	1121
7	...	...	...	...	5·80	4395	3·71	2558	5·83	4425	3·08	2081	1·60	1075
8	...	...	...	...	5·72	4315	4·10	2870	5·80	4395	2·91	1962	1·40	945
9	...	...	...	...	5·66	4255	4·30	3035	5·73	4325	2·78	1871	1·40	945
10	...	...	...	...	5·59	4186	4·82	3478	5·63	4225	2·71	1822	1·46	984
11	5·88	4475	...	...	5·52	4119	4·96	3604	5·55	4148	2·80	1885	1·58	1062
12	6·44	50·9	...	...	5·38	3986	5·36	3967	5·55	4167	2·76	1857	1·54	1036
13	6·74	5406	...	...	4·96	3604	5·50	4100	5·57	4148	2·71	1822	1·52	1023
14	8·61	7804	...	...	4·80	3460	5·66	4255	5·50	4100	2·56	1717	1·52	1023
15	8·59	7777	...	...	4·72	3392	5·80	4395	5·42	4024	2·42	1619	1·50	1010
16	8·68	7898	...	...	4·60	3290	6·01	4611	5·28	3892	2·29	1528	1·48	997
17	8·52	7682	...	...	4·45	3163	6·10	4705	5·15	3775	2·24	1493	...	1000
18	8·50	7655	...	...	4·33	3061	6·33	4948	5·08	3712	2·17	1446	...	1000
19	8·48	7628	...	...	4·22	2967	6·45	5080	4·62	3307	2·12	1413	...	1000
20	8·48	7628	9·94	9599	3·84	2662	6·50	5135	3·89	2702	2·05	1368	1·50	1010
21	8·56	7736	8·77	8020	3·79	2622	6·55	5190	3·76	2598	1·99	1329	1·49	1004
22	8·61	7804	8·61	7804	3·70	2550	6·60	5245	3·81	2638	1·85	1238	1·50	1010
23	8·66	7871	8·39	7507	3·62	2486	6·58	5223	3·70	2550	1·76	1179	1·60	1075
24	8·83	8101	8·12	7142	3·54	2425	6·53	5168	3·62	2486	1·75	1173	1·65	1108
25	8·86	8141	7·93	6886	3·40	2320	6·50	5135	3·78	2614	1·74	1166	1·61	1082
26	8·99	8317	7·78	66·9	3·30	2245	6·45	5080	3·88	2694	1·74	1166	...	...
27	...	...	7·63	6491	3·22	2185	6·42	5047	3·65	2510	1·73	1160	...	...
28	...	...	7·21	5963	3·21	2178	6·30	4915	3·60	2470	1·73	1160	...	...
29	...	...	7·01	5722	3·22	2185	6·18	4789	3·62	2486	1·73	1160	...	...
30	...	...	6·79	5464	3·24	2200	6·10	4705	3·56	2440	1·70	1140	...	...
31			6·82	5498	...	...	6·02	4621	3·50	2395	...	...	...	...

TABLE No. 53.

DISCHARGE MEASUREMENTS of Assiniboine River, at Headingly, 1913.

Date.	Hydrographer.	Meter No.	Width.	Area of Section.	Mean Velocity.	Gauge Height.	Discharge.
1913.			Feet.	Sq. Ft.	Ft. per sec.	Feet.	Sec.-ft.
Apr. 16..	G. H. Burnham	1497	317	2543	3·02	6·85	7673
" 22..	E. Bankson	1469	366	2719	3·40	7·70	9258
May 2..	E. Bankson	1469	366	2888	3·58	8·06	10337
" 7..	G. Ebner	1187	395	3516	3·83	9·61	13464
" 12..	G. Ebner	1186	372	3526	3·86	9·78	13610
" 19..	G. Ebner	1186	370	3118	3·35	8·73	10447
June 23..	G. Ebner	1186	260	1587	2·20	4·13	3491
July 19..	A. Pirie	1496	360	1835	2·36	4·89	4335
Aug. 5..	W. J. Ireland	1469	302	1977	2·41	5·02	4759
" 14..	W. J. Ireland	1469	301	1952	2·44	4·83	4526
" 18..	G. Ebner	1196	261	1871	2·32	4·89	4276
Sept. 16..	C. O. Allen	1435	248	1194	1·64	2·80	1959
" 27..	E. Budge	1186	235	1079	1·44	2·32	1551
Oct. 13..	Ireland and Edmondson	1469	238	1007	1·19	1·95	1201

TABLE No. 54.

Daily Gauge Height and Discharge, Assiniboine River, at C.P.R. Bridge, Headingly, for 1913.

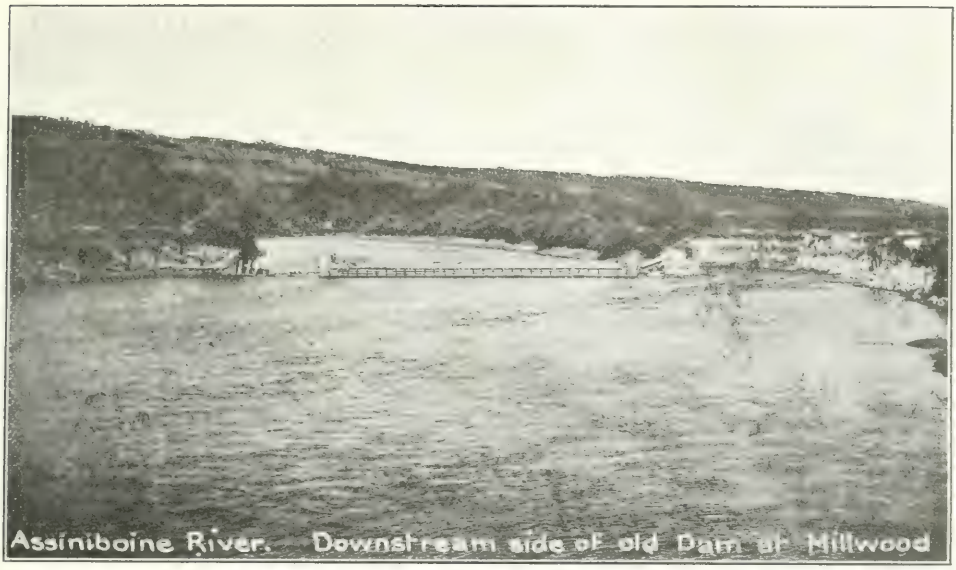
Day.	April.		May.		June.		July.		August.		September.		October.	
	Gauge Height	Discharge	Gauge Height	Discharge	Gauge Height.	Discharge	Gauge Height	Discharge	Gauge Height	Discharge	Gauge Height	Discharge	Gauge Height.	Discharge
	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	.....	8·0	9885	6·35	6768	3·9	3080	5·3	5035	3·5	2640	2·08	1390
2	.....	.....	8·5	10905	6·28	6645	3·7	2855	5·22	4911	3·55	2693	1·98	1315
3	.....	.....	8·2	10290	6·12	6369	3·45	2588	5·18	4849	3·45	2588	1·96	1300
4	.....	.....	8·4	10700	6·02	6199	3·38	2515	5·11	4741	3·4	2535	1·98	1315
5	.....	.....	8·9	11745	5·91	6022	3·3	2435	5·04	4635	3·4	2535	1·98	1315
6	.....	.....	9·37	12756	5·9	6005	3·3	2435	5·0	4575	3·37	2505	1·88	1241
7	.....	.....	9·87	13849	5·8	5880	3·29	2415	4·97	4530	3·3	2435	1·78	1171
8	.....	.....	9·97	14069	5·7	5675	3·21	2345	4·97	4530	3·2	2335	1·68	1101
9	.....	.....	9·89	13893	5·6	5510	3·2	2335	4·9	4425	3·1	2235	1·76	1157
10	.....	.....	9·92	13959	5·5	5355	3·3	2435	4·89	4411	3·3	2435	1·88	1241
11	.....	.....	9·97	14069	5·4	5195	3·5	2640	4·91	4440	3·3	2435	1·90	1255
12	.....	.....	9·91	13937	5·3	5035	3·7	2855	4·95	4500	3·08	2217	2·00	1330
13	.....	.....	9·81	13717	5·12	4755	3·8	2965	4·9	4425	3·0	2145	1·96	1300
14	.....	.....	9·67	13429	5·1	4725	4·0	3200	4·84	4338	3·0	2145	1·88	1241
15	.....	.....	9·37	12756	5·0	4575	4·3	3585	5·0	4575	2·9	2055	1·82	1199
16	.....	.....	9·17	12326	4·9	4425	4·49	3842	5·0	4575	2·8	1965	1·76	1157
17	6·5	7030	9·02	12003	4·8	4280	4·58	3967	5·0	4575	2·75	1923	1·76	1157
18	7·5	8895	8·96	11874	4·6	3995	4·8	4280	4·9	4425	2·7	1880	1·73	1136
19	7·6	9090	8·81	11556	4·5	3855	4·85	4353	4·7	4135	2·6	1795	1·78	1171
20	7·8	9485	8·68	11283	4·4	3720	4·9	4425	4·6	3995	2·5	1715	1·86	1227
21	7·75	9385	8·5	10905	4·3	3585	5·5	5355	4·4	3720	2·45	1675	1·87	1234
22	7·7	9285	8·32	10536	4·2	3455	5·12	4755	4·2	3455	2·4	1635	1·78	1171
23	7·7	9285	8·19	10270	4·1	3325	5·22	4911	4·0	3200	2·38	1614	1·70	1115
24	7·7	9285	8·0	9885	4·0	3260	5·31	5051	3·95	3140	2·38	1614	1·73	1136
25	7·75	9385	7·8	9485	3·9	3080	5·4	5195	3·85	3023	2·38	1614	1·87	1234
26	7·8	9485	7·6	9090	3·9	3080	5·4	5195	3·65	2800	2·3	1550	1·78	1171
27	7·85	9585	7·3	8510	3·8	2965	5·4	5195	3·5	2640	2·18	1465	1·78	1171
28	7·83	9545	7·1	8125	3·8	2965	5·39	5179	3·48	2619	2·18	1465	1·56	1017
29	8·4	10700	6·9	7755	3·65	2800	5·4	5195	3·5	2640	2·08	1390	1·48	961
30	8·6	9885	6·7	7390	3·58	2833	5·4	5195	3·57	2714	2·08	1390	1·38	892
31	.....	.....	6·5	7030	.....	.....	5·32	5067	3·6	2745	.....	.....	1·28	827

TABLE No. 55.

Discharge Measurements of Assiniboine River, at St. James, 1912-13.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity	Gauge height.	Discharge.
1912.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 14	S. S. Scovil	1186	291	1227	4·78	4·75	5864
" 25	G. H. Burnham	1187	356	1160	4·81	5·33	7021
June 11	" "	1187	357	1608	4·87	5·90	7852
" 24	" "	1187	293	1118	4·35	4·22	4841
July 1	" "	1187	291	1087	4·07	3·89	4425
" 8	" "	1187	285	911	3·63	3·20	3308
" 23	" "	1187	285	863	3·08	2·71	2659
Aug. 3	W. G. Worden	1187	285	799	2·78	2·45	2221
" 27	" "	1187	280	728	2·63	2·17	1914
Sept. 24	A. Pirie	1187	290	1102	4·04	3·75	4450
Oct. 8	R. H. Nelson	1187	295	1429	4·31	4·73	6161
" 30	" "	1197	285	916	3·35	2·87	3063
Dec. 28	H. M. Nelson	1197	285	779	1·35	3·63	1052[1]
1913.							
Jan. 17	A. Pirie	1469	263	399	1·31	2·63	522[1]
Mar. 7	G. H. Burnham	1197	197	317	1·38	2·83	437[1]
May 3	E. Bankson	1469	360	2242	4·49	7·87	10056

[1] Ice Cover



Assiniboine River. Downstream side of old Dam at Millwood

Assiniboine River. Looking downstream from side of old Dam at Millwood

Brandon Power Surveys - Assiniboine River - Currie's Landing Rapids looking upstream

Brandon Power Surveys - Assiniboine River - Two miles above Currie's Landing
C. N. Ry. Bridge.

SESSIONAL PAPER No. 25e

The Little Saskatchewan.

A.—LOCATION AND DIRECTION.

The Little Saskatchewan (see plate No. 12), rises in the southerly part of Riding Mountain Forest reserve and flows in a southeasterly direction until it reaches the town of Minnedosa. At this town the river bends through almost a right angle, and flows in a southwesterly direction until within about fifteen miles of its mouth when it again resumes its original course to the southeast and joins the Assiniboine river. The point of junction with the latter river is eight miles west of the city of Brandon and almost directly south of the head-waters.

B.—RIVER BASIN.

The watershed of the river covers an area of 1,640 square miles, the greater part of which is hilly and undulating. The width of the basin in the upper reaches approximates forty-five miles, and its length from mouth to head-waters, sixty miles. In the country forming the upper basin of the river are to be found numerous small lakes draining into the upper tributaries, and it is in this section that most of the drainage is obtained, as in the lower reaches of the river very few tributaries are met with. The largest single drainage entering the river is encountered about thirteen miles north of the town of Minnedosa and is called the Rolling river.

C.—NATURE OF BANKS.

The course of the river throughout is very winding and though, as above noted, the length of the basin from head-waters to mouth is sixty miles, the actual length of the river itself is one hundred and twenty-five miles.

The valley of the river is well marked throughout its length. The banks vary in height from one hundred to three hundred feet, while the width between banks varies from one thousand feet to a mile and a quarter.

The nature of the soil is mostly a sandy clay, and, in some parts, particularly on the lower levels, is thickly strewn with boulders. This soil generally overlays a stratum of gravel and, at a depth of about five feet, blue clay is encountered in most sections. Pockets of quicksand are also met with, but these are not common.

D.—WIDTH OF RIVER AND NATURE OF BED.

The river, almost throughout its entire length, flows over a bed composed of fine gravel and sand, though in some localities it is thickly covered with large boulders.

In width the natural bed varies from fifty to ninety feet.

No rock outcrops have been noted, and it is not likely that rock will be met with in any part of the river.

E.—TIMBER AND VEGETATION.

In the upper reaches of the river a considerable amount of valuable timber has been observed but, with this exception, very little marketable timber is to be had, the country being well settled and the land mostly broken throughout the entire basin. The unbroken land is mostly covered with small poplar and scrub.

The basin of this river is probably one of the oldest settled in the province. The soil is rich and the section north of Minnedosa is noted for its oat crops, while in the southern part, wheat forms the larger proportion of the crop.

F.—TRANSPORTATION AND ACCESSIBILITY.

The river is not large enough for navigation except by row-boat or canoe. Throughout its course, with the possible exception of the extreme upper portion of its basin, the roads are in very good condition, and the river easily accessible from same. It is also in close touch with the different railroads throughout the lower one hundred miles of its course, and is crossed by them at eight different points. At no place in this distance is the river distant from a railroad by more than six miles.

G.—SETTLEMENTS.

The land throughout the basin is well settled and, in the course of the river, are encountered the settlements of Rivers, Gautier, Rapid City, Riverdale, Minnedosa, Rolling River and Elpinstone. Of these the largest and most important are Minnedosa, Rapid City, the former having a population of about seventeen hundred and the latter about five hundred and eighty.

H.—RUN-OFF.

(*a*) *Rainfall.*—Rainfall records for the town of Minnedosa, covering a period of thirty-two years, give the mean annual precipitation as being eighteen inches.

(*b*) *Discharge Measurements.*—A gauging station was established on this river at Riverdale by the Manitoba Hydrographic Survey during January of the present year, and since that time investigations as to flow during the different stages of the river have been made.

These investigations include eight meterings, the results of which are given in table No. 56.

A record of the daily gauge heights has also been kept, and these, with their assumed discharges, will be found on the daily discharge table No. 57.

I.—HIGH AND LOW WATER.

As is shown in table No. 57, it will be seen that there is an extreme variation between flood and low water of slightly over five feet. The flood conditions lasted on the river for a period of three weeks, and, with the exception of this time, the variation in the stage of the river amounted to a maximum of 2·7 feet.

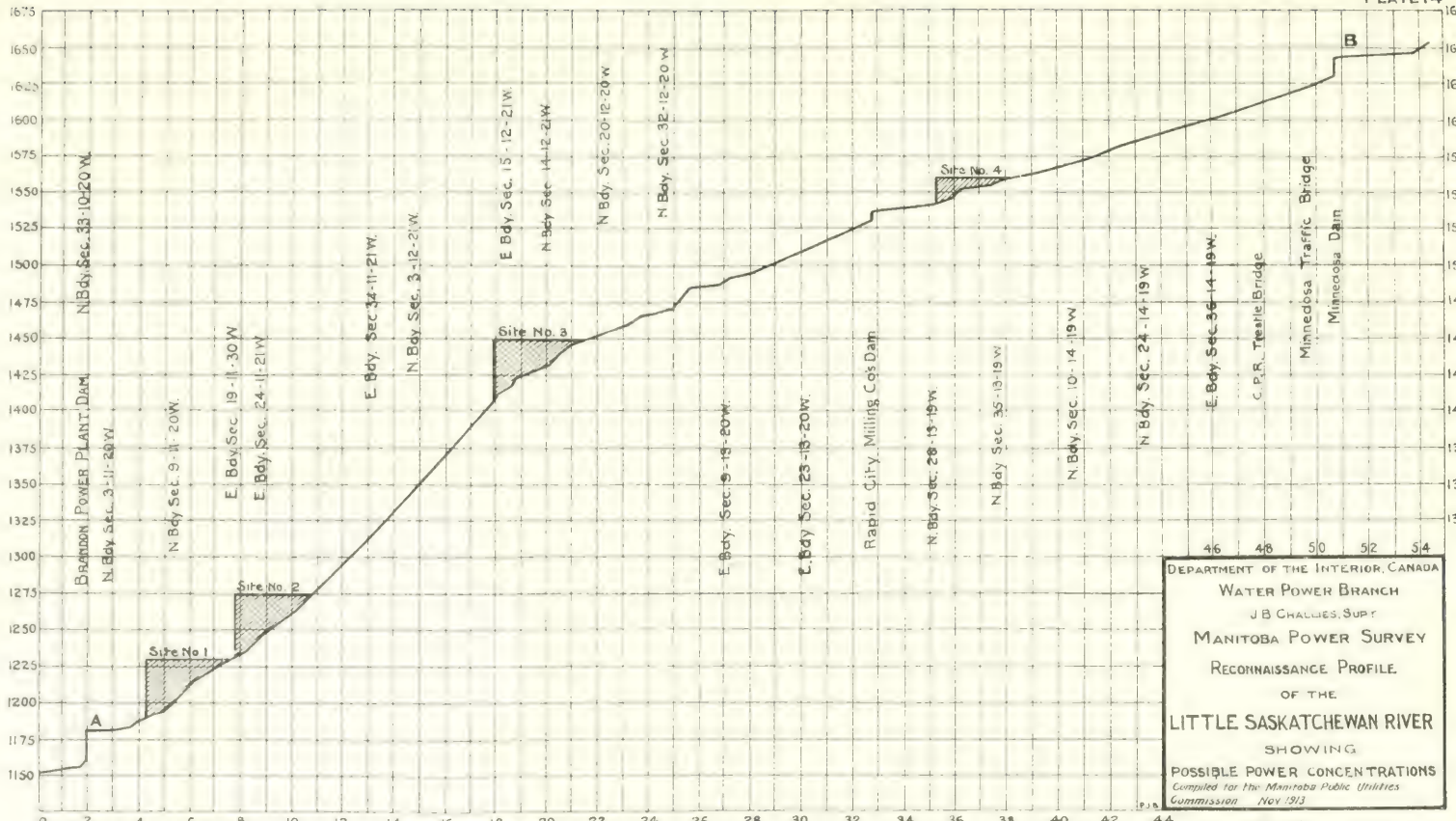
J.—SURVEYS.

(*a*) The land throughout the drainage area has been surveyed and subdivided by the Dominion Land Survey.

(*b*) A reconnaissance survey for the purpose of locating available water-power sites was made on the river during the summer of this year by the Manitoba Power Survey, under the direction of the late G. H. Burnham.

Location work was carried out from the Assiniboine to a point about four miles above the town of Minnedosa, and investigations as to possible storage were made up to the head-waters above the town of Elphinstone. The accompanying map, plate No. 12, and profile of the river, plate No. 14, give the location of four possible dam sites and also the two existing developments, as investigated by this survey.

PLATE 14



DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
J B CHALLIES, SUPT

MANITOBA POWER SURVEY

RECONNAISSANCE PROFILE
OF THE

LITTLE SASKATCHEWAN RIVER

SHOWING
POSSIBLE POWER CONCENTRATIONS

Compiled for the Manitoba Public Utilities Commission NOV 1913

Douglas L. McLegan — Chief Engineer
Stuart S. Scott — Asst Chief Engineer

K.—STORAGE.

The lake and stream areas, with their accompanying low land and marshes in the upper basin which could be utilized for storage purposes, are as follows:—

	Acres.
Andy lake, including Big Jackfish creek	1,000
Jackfish lake	1,280
Bottle and Spruce lakes	1,100
Squaw creek	2,500
Clear lake	8,960
Proutts lake	350
Stuarts lake	650
Oak lake	1,300
Thomas lake	2,000
Beauford lake	600
Long lake	1,800
Sandy lake	2,500

The total surface area obtainable for storage purposes in connection with these lakes is 24,040 acres.

The amount of storage per foot on the above area is 1,047 billion cubic feet.

L.—MASS CURVE.

From mass curve studies, plate No. 15, made in connection with the discharge data obtained during the year of 1913, we find that to maintain a uniform discharge of 230 second-feet, there would be required a properly regulated storage on the head-water lakes of 3·16 billion cubic feet, or an average depth of 3·01 on the above-mentioned storage areas.

M.—WATER-POWER.

There is a difference in elevation of 490 feet between the water levels at the point of junction of the Little Saskatchewan with the Assiniboine, and a point four miles above the town of Minnedosa.

In this length of the river the possibility of concentrating a portion of the natural fall at six different locations has been investigated. At two of these points development work has been done, and these, with the other possible developments and their estimated horse-powers, are listed below.

Based on estimates of flow for the year ending October 31, 1913, the following table gives the power available at an 80 per cent efficiency, and is computed for a low flow of 50 second-feet, and also for an estimated regulated flow of 230 second-feet.

Power Site.	Estimated Horse Power at 80 Per Cent Efficency.		
	Head.	Low Flow 50 sec.-ft.	Regulated Flow 230 sec.-ft.
Brandon Electric Light Co.	33	149	690
Minnedosa Power Co.	14	108	504
Dam Site No. 1	40	180	840
" " 2	45	203	945
" " 3	47	212	987
" " 4	20	90	420

N.—POWER DEVELOPMENTS.

(a) The Brandon Electric Light Co.

The Brandon Electric Light Company own and operate a water-power on the river about half a mile above its junction with the Assiniboine.

This plant is used throughout the summer months, but is shut down and held as a possible auxiliary to the company's steam plant during the winter. This reversal of the usual custom is accounted for by the fact that the company sell their exhaust steam through the winter months for heating purposes, and in that way actually have a source of revenue above the cost of fuel used for generating power.

This development comprises an earth dam 25 feet high and 450 feet long, with a wooden spillway 68 feet wide.

The power-house is a frame building erected immediately below the dam.

Plant has been installed here for the development of from 400 to 600 k.w. under a head of 33 feet.

(b) The Minnedosa Power Co.

The location on the river which has been developed by the Minnedosa Power Company is situated within half a mile of the town of Minnedosa.

Work was commenced on this development in January of 1910 and the plant, though not completed, started operating under a head of 17 feet in the spring of the present year. It is claimed that this head is increased to 24 feet under completed conditions. This head has been made possible by the erection of an earth dam, 1,800 feet long.

A frame generator and turbine house is situated about 400 feet below the dam, and the water is carried from the intake to a 450 horse-power turbine, through a 6-foot wood stave pipe line. (See page 123.) Provision has been made for doubling the capacity of the plant as the demand for power increases. At the opposite end of the dam to the intake is located a concrete spillway, 60 feet wide.

It is stated that the company has the right to raise the level of the water in Clear lake 5 feet for the purpose of obtaining storage to carry the plant over periods of low flow, and a photo of the timber dam erected for this purpose is shown on page 123.

TABLE No. 56.

DISCHARGE MEASUREMENTS of Little Saskatchewan River, at Riverdale, 1913.

Date.	Hydrographer.	Meter No.	Width.	Area of Section.	Mean Velocity.	Gauge Height.	Discharge.
			Feet.	Sq. Ft.	Ft. per sec.	Feet.	Sec.-ft.
Jan. 24	G. Lamb	1374	77	68	0·85	3·17	57[1]
Feb. 18	A. Pirie	1462.9	65	69	0·89	4·33	61
Apr. 16	S. S. Scovil	1469	95	318	3·03	5·15	966
May 8	E. Bankson	1469	94	241	2·55	4·2	617
July 1	A. Pirie	1496	93	225	1·91	3·74	430
Aug. 8	W. J. Ireland	1469	87	154	1·01	3·18	168
Sept. 11	W. J. Ireland	1469	88	134	0·67	2·84	89
Oct. 17	C. O. Allen	1435	81	117	0·73	2·88	85

[1]Ice measurement

TABLE

Daily Gauge Height and Discharge, Little

Day.	January.		February.		March.		April.		May.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1							4·10		4·80	835
2							4·16		4·70	794
3							4·36		4·96	901
4							4·56		4·36	655
5							4·48		4·95	896
6			4·40		4·16		4·53		4·43	683
7							4·58		4·20	589
8							4·62		4·20	589
9							4·66		4·11	552
10							4·70		4·10	548
11							6·10	1368	4·60	753
12							7·50	1942	4·30	630
13			4·20		4·50		6·70	1614	4·00	507
14							6·00	1327	4·00	507
15							5·20	999	4·00	507
16							5·42	1089	3·90	467
17							5·31	1044	3·90	467
18			4·33				5·10	958	3·29	223
19							5·71	1208	3·29	223
20			4·93		4·63		5·92	1294	3·19	184
21							5·61	1167	3·90	467
22							5·21	1003	3·88	459
23							5·51	1126	3·78	419
24	3·17						5·11	962	3·80	427
25							5·90	1286	3·97	495
26							5·10	958	3·87	455
27			4·44		4·95		5·70	1204	3·80	427
28							5·30	1040	3·80	427
29							5·20	999	3·80	427
30	2·95						4·00	507	3·80	427
31									3·18	180

SESSIONAL PAPER No. 25e

No. 57.

Saskatchewan River, near Riverdale, Man., for 1913.

June.		July.		August.		September.		October.		Day.
Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
3·77	415	3·80	427	3·60	347	3·00	126	2·50	32	1
3·77	415	3·50	307	3·40	267	2·49	31	2·60	44	2
3·70	387	3·60	347	3·40	267	3·00	126	2·90	101	3
3·86	451	3·46	291	3·44	283	2·69	58	2·28	13	4
3·80	427	3·80	427	3·30	227	2·49	31	2·90	101	5
3·20	187	3·60	347	3·20	187	2·28	13	2·80	78	6
3·50	307	3·80	427	3·30	227	2·90	101	2·80	78	7
3·85	447	3·47	295	3·92	475	2·70	59	2·90	101	8
3·60	347	3·80	427	3·61	351	2·90	101	2·47	29	9
3·95	487	3·56	331	3·83	439	2·88	96	2·90	101	10
3·10	154	3·80	427	3·30	227	2·88	96	2·68	56	11
3·48	299	3·48	299	3·20	187	2·24	12	2·90	101	12
3·30	227	3·70	387	3·00	126	2·50	32	2·70	59	13
3·40	267	3·48	299	3·20	187	2·80	78	2·90	101	14
3·30	227	3·90	467	3·10	154	2·44	26	2·80	78	15
3·70	387	3·29	223	3·10	154	2·45	27	2·27	13	16
3·40	267	3·80	427	3·10	154	2·50	32	2·47	29	17
3·47	295	3·90	467	2·89	99	2·80	78	2·80	78	18
3·80	427	4·00	507	3·20	187	2·80	78	2·70	59	19
3·30	227	3·90	467	3·22	195	2·45	27	2·68	56	20
3·14	167	3·49	303	3·42	275	2·50	32	2·87	94	21
3·62	355	3·90	467	3·83	439	2·83	85	2·68	56	22
3·73	399	3·86	427	3·81	431	2·90	101	2·88	96	23
3·60	347	3·66	371	3·30	227	2·80	78	2·48	30	24
3·23	199	3·26	211	3·42	275	2·80	78	2·80	78	25
3·45	287	3·60	347	3·10	154	2·50	32	2·28	13	26
3·65	367	3·60	347	3·00	126	2·60	44	2·48	30	27
3·60	347	3·85	447	2·89	99	2·60	44	2·80	78	28
3·70	387	3·60	347	3·00	126	2·90	101	2·70	59	29
3·70	387	3·46	291	3·40	267	2·40	22	3·00	126	30
.....	.....	3·70	387	3·00	126	....		3·41	271	31

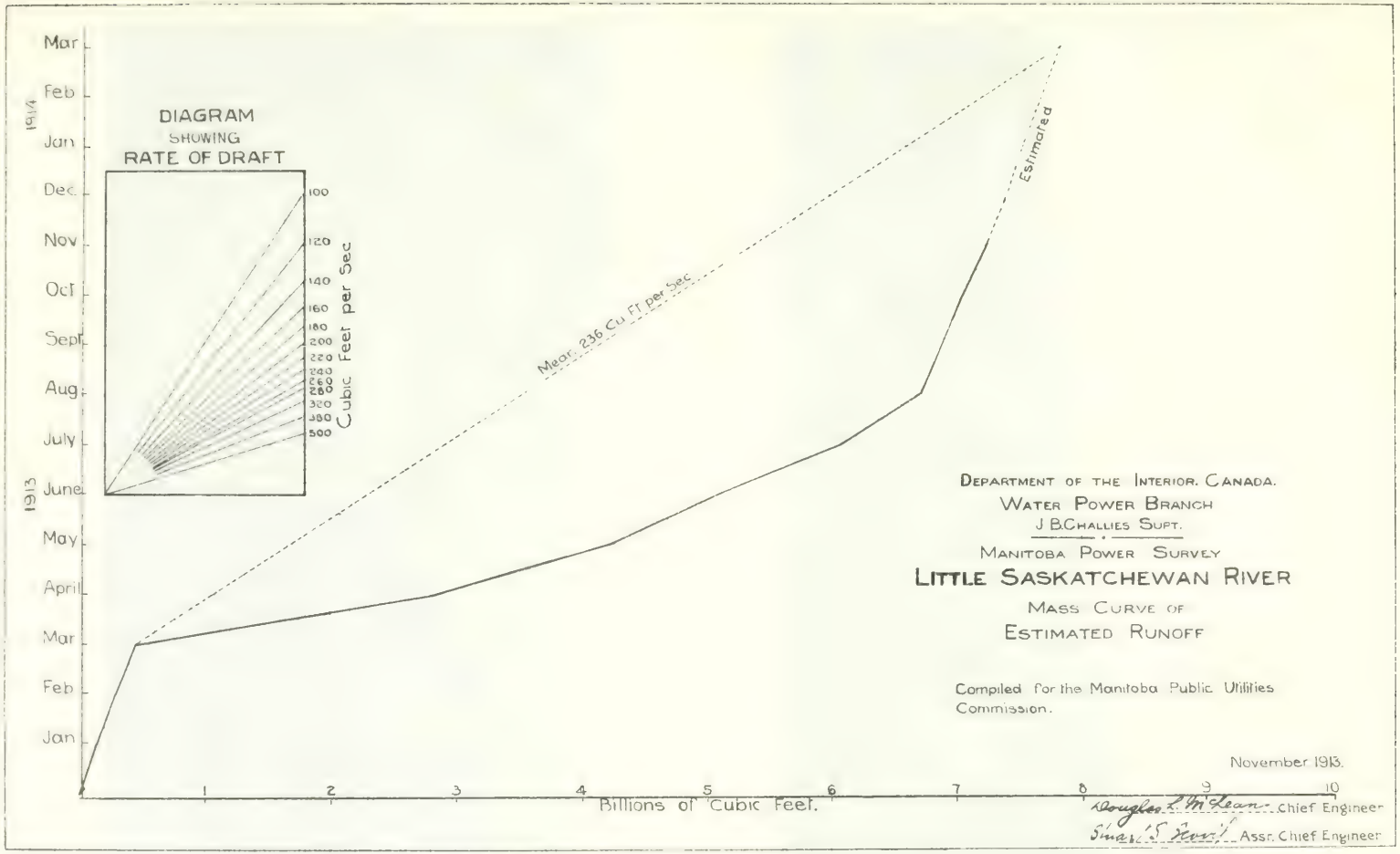
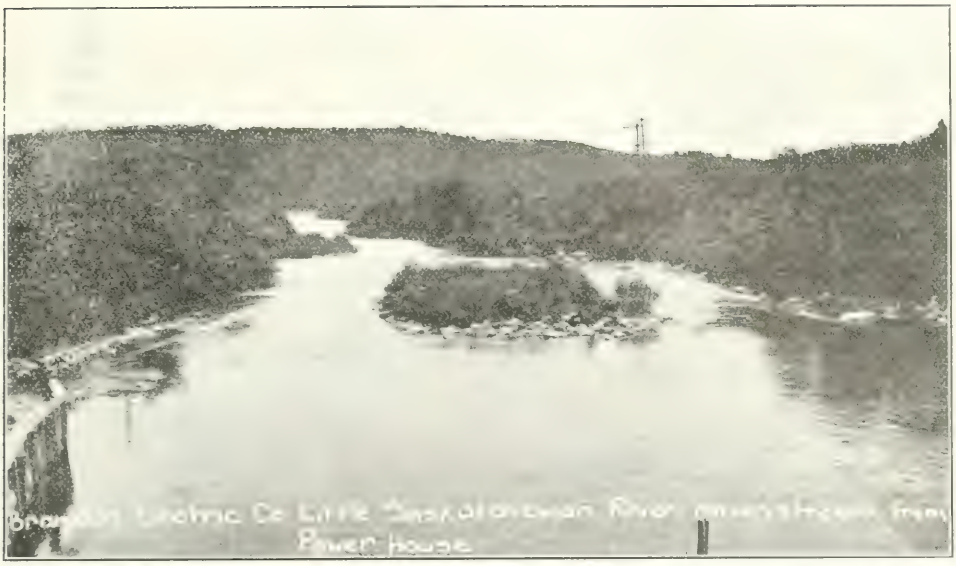


DIAGRAM
SHOWING
RATE OF DRAFT
Cubic Feet per Sec
100
120
140
160
180
200
220
240
260
280
300
320
380
500
1914
1913
Mar
Feb
Jan
Dec
Nov
Oct
Sept
Aug
July
June
May
April
Mar
Feb
Jan
Mean 236 Cu Ft per Sec
Estimated
1
2
3
4
5
6
7
8
9
10
Billions of Cubic Feet.
DEPARTMENT OF THE INTERIOR. CANADA.
WATER POWER BRANCH
J.B.CHALLIES SUPT.
MANITOBA POWER SURVEY
LITTLE SASKATCHEWAN RIVER
MASS CURVE OF
ESTIMATED RUNOFF
Compiled for the Manitoba Public Utilities Commission.
November 1913.
Douglas R. McLean Chief Engineer
Assr. Chief Engineer

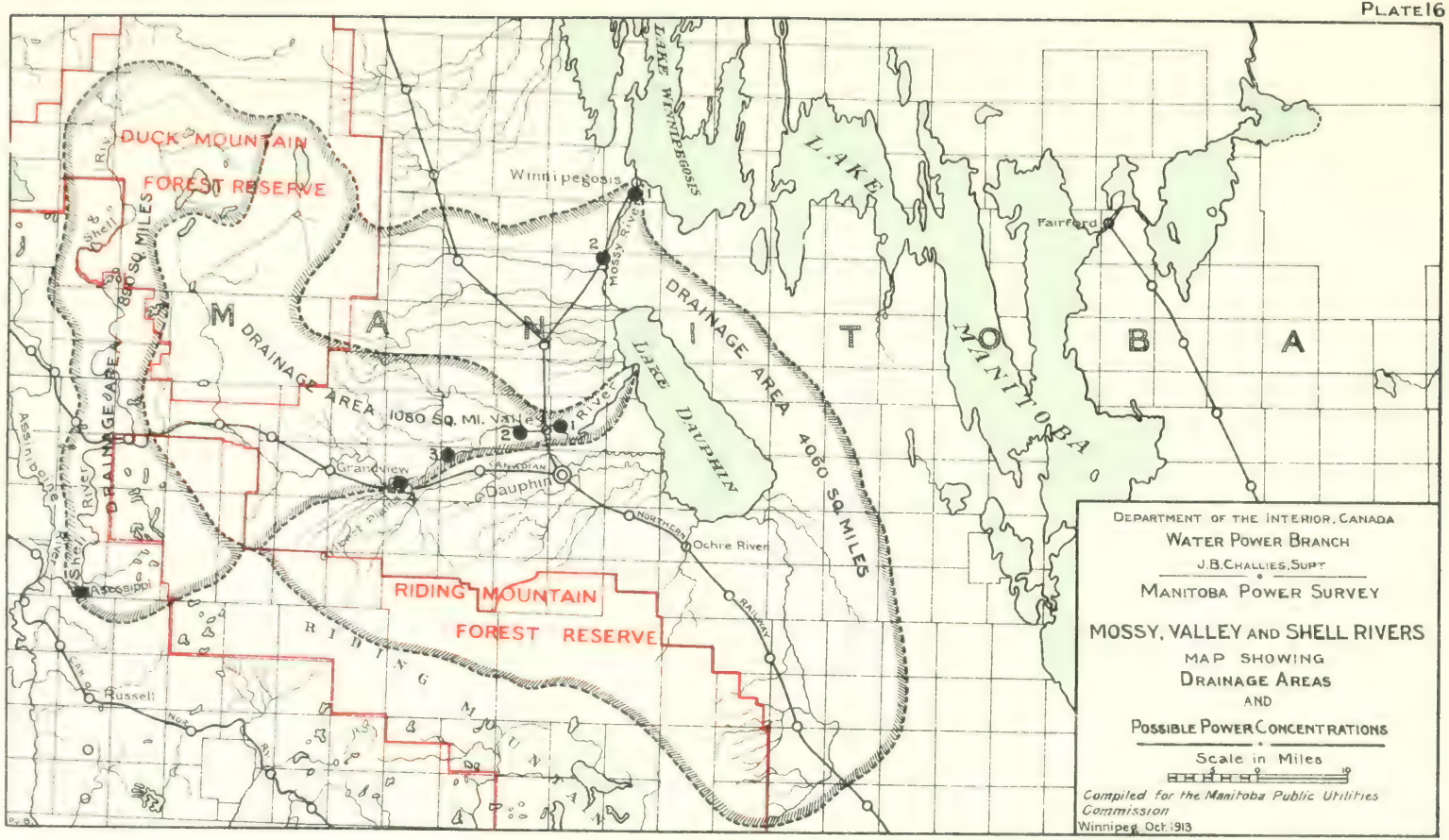
Little Saskatchewan River, Minnedosa Power Co. — Intake flume and Power House

Little Saskatchewan River, Clear Lake — Downstream side of Dam at outlet

Brandon Electric Co. Little Saskatchewan River Power House


Power House

C.P.Ry. Bridge at Rivers.



DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
J.B. CHALLIES, SUPT
MANITOBA POWER SURVEY

MOSSY, VALLEY AND SHELL RIVERS

MAP SHOWING
DRAINAGE AREAS
AND
POSSIBLE POWER CONCENTRATIONS

Scale in Miles

Compiled for the Manitoba Public Utilities Commission
Winnipeg Oct. 1913

Douglas L. McLean, Chief Engineer
Stuart L. Scott, Asst Chief Engineer

WATER-POWERS OF MANITOBA.

CHAPTER V.

RIVERS IN WESTERN CENTRAL PORTIONS OF MANITOBA.

CHAPTER V.

RIVERS OF WESTERN CENTRAL PORTION OF MANITOBA.

Valley River.

A.—LOCATION.

The Valley river, so called since it flows in the valley between the Riding and Duck mountains, rises in the Duck Mountain Forest Reserve and discharges into lake Dauphin. (*See* plate No. 16.)

B.—RIVER BASIN.

Singoosh lake, which lies in the northerly part of the Duck mountains, is stated to be the source of the river. From this lake the flow is in a southwesterly direction to East Angling lake, into which the tributary drainage from Laurie and West Angling lakes enters from the north. From East Angling lake the river flows southerly a distance of some 16 miles, and then bends in an easterly direction, continuing this latter course until it empties into lake Dauphin. Near the easterly bend, Short creek, which rises in Riding Mountain Forest reserve and drains several small lakes, enters the Valley river from the west. Below this the main drainage to the river enters from the north, chief among the tributaries being the Drifting river, which joins the Valley river some three miles west of Valley river station on the Canadian Northern railway.

C.—NATURE OF BED AND BANKS.

In the reaches below the Duck Mountain Forest reserve the river flows in the valley lying between the Duck and Riding mountains, the banks vary in height from 15 to 85 feet, while the width of the bottom land ranges from 700 to 2,000 feet, widening in some few places to 3,000 feet. The river at ordinary summer stages has a width varying from 100 to 200 feet; the banks are composed of yellow clay overlying a bed of gravel and boulders. Investigations carried on at several points in that portion of the river lying between Gilbert Plains and Valley River station, have shown a depth of clay varying from 6 to 30 feet overlying the gravel strata. The bed of the river is of gravel, strewn with boulders.

D.—TIMBER AND VEGETATION.

In the upper watershed there is considerable growth of valuable timber, comprising spruce, jackpine and poplar. Lower down the river the valley bottom and banks are covered with a growth of scrub oak, poplar and briar. Very little clearing has been done in the immediate vicinity of the river, but grain growing and mixed farming are carried on to a considerable extent in the adjacent country.

E.—HIGH AND LOW WATER.

High water usually occurs at the time of the spring break-up in April; the river, however, is subject to extreme fluctuations in the open-water season, heavy rains in

the head-water giving rise to floods in the lower valleys. Low water occurs in the fall and winter months.

F.—TRANSPORTATION AND ACCESSIBILITY.

Due to shoals and rapids, navigation of the river is impossible other than by row-boat or canoe. The river is accessible by many township roads and is also crossed by the Canadian Northern railway at Valley river, Grandview and Stravel, and in no place between these crossings is it more than five miles distant from the railway.

G.—SETTLEMENTS.

The country adjacent to the Valley river is well settled by farmers, while several thriving villages, such as Gilbert Plains, Grandview and Valley River are in the immediate vicinity. The town of Dauphin, which is the center of this agricultural district, lies some six miles south from the nearest point on the river.

H.—SURVEYS OF THE RIVER.

Outside the boundaries of the forest reserves, all townships have been surveyed. A geological survey of the river from lake Dauphin to Angling lake was made in the year 1887 by the Geological Survey of Canada. In October, 1912, a meter station was established at the Canadian Northern Railway bridge near Valley River post office by the Manitoba Hydrographic Survey. In the following summer a reconnaissance survey of the power possibilities of that portion of the river from Gilbert Plains to a point some four miles below Valley River post office was carried on by the Manitoba Power Survey, operating under the Water-power Branch of the Department of the Interior. In the fall of the same year a preliminary investigation of the storage possibilities of the upper watershed was made by Mr. D. B. Gow, who previously had been in charge of the field party carrying on the power survey.

I.—RUN-OFF.

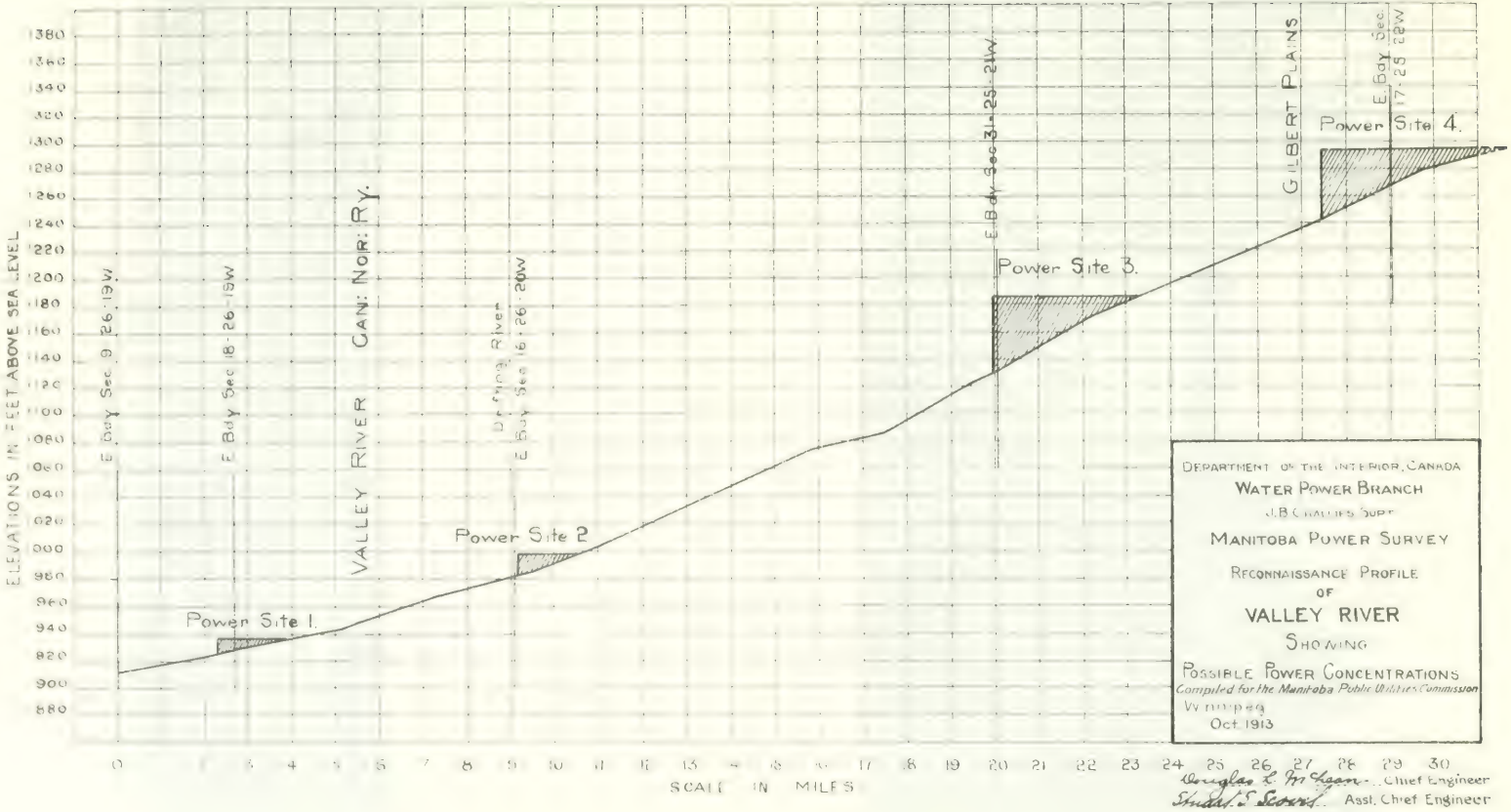
(*a*) *Rainfall.*—Rainfall records extending over a sufficient period of time are not available for this drainage area. Records of rainfall at Minnedosa, which lies to the southeast of the Valley River basin, but to which, to a great extent, the same physical conditions apply, show a mean annual rainfall of 18 inches for a period of 32 years.

(*b*) *Discharge Measurements.*—Measurements of the flow of the river have been made at the C.N.R. bridge, near Valley River post office, by the Manitoba Hydrographic Survey during the past year, the results of this work being given in table No. 58. An estimate of the daily discharges for the year ending October 31, 1913, as given in tables No. 59 and No. 60, shows a low flow of 20 second-feet occurring in January, February and March. The maximum flow recorded at the time of the spring break-up was 2,760 second-feet, but during the month of July the river reached flood stage, due to exceptionally heavy rains, and showed a maximum discharge of some 3,500 second-feet.

J.—STORAGE POSSIBILITIES.

No definite information is available with reference to all the lakes lying in the head-waters of the drainage basin. From a reconnaissance investigation of the Angling lakes, it would be possible to obtain a 5-foot storage on North Angling lake and a 3-foot storage on East Angling lake, the latter lake being a collecting basin of the major portion of the upper drainage. In the case of the former lake, the topo-

PLATE 17



DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
J.B. CHALLIES, SUPT.

MANITOBA POWER SURVEY

RECONNAISSANCE PROFILE
OF
VALLEY RIVER
SHOWING
POSSIBLE POWER CONCENTRATIONS

Compiled for the Manitoba Public Utilities Commission

Winnipeg
Oct. 1913

Douglas L. McLean ... Chief Engineer
Stuart S. Scott ... Asst. Chief Engineer

Valley River. Mc. Pherson Dam site. Reach above and below D.L. July 29th, 1913

Valley River, at Outlet of East Anding Lake

Valley River – Damsite No. 2. Base Line from Left bank

graphical features of the shores and outlet would permit of greater depth of storage, but the depth as given has been estimated as being all that the tributary run-off would require. This same feature applies to Singoosh lake, which, though it has not as yet been investigated, is stated locally to be capable of a storage of 10 feet. While further storage might be obtained on other small lakes, the following table gives an estimate of that available on the three above-mentioned lakes:—

Lake.	Area in Acres.	Depth of Storage in Feet.	Storage in Cubic Feet.
East Angling	288	3	37,700,000
North Angling	230	5	50,100,000
Singoosh	2,880	3	376,500,000
Total			464,300,000

From mass curve studies of the run-off of the Valley river for the year ending October 31, 1913, it is estimated that the low flow of the river during winter months could be increased from 20 second-feet, as found in 1913, to 60 second-feet by the utilization of this storage.

K.—WATER-POWER.

The following table gives the estimated power available at four possible power sites in that portion of the river investigated as shown on profile plate No. 17.

The estimated power, based on an 80 per cent efficiency, has been computed under three separate headings:—

(1) On a minimum flow of 20 second-feet as recorded during the winter of 1912-1913.

(2) On a regulated flow of 60 second-feet, it being estimated that the low flow could be increased by regulation to this amount.

(3) On a flow of 100 second-feet, this being the lowest mean monthly flow for a period of six months from April to September, inclusive, and consequently the estimated power under this heading only applies to the period as given.

All estimates of power are based on run-off data for the year ending October 31, 1913, and as these records do not cover an extended period of time, the estimates of the flow are therefore subject to a revision:—

Power Site.	Estimated Horse Power on 80% Efficiency.			
	Head.	Min. Flow.	Regulated Flow.	Lowest monthly mean, 6 mos., April-Sept.
No. 1	19	34	102	172
No. 2	19	34	102	172
No. 3	56	101	303	504
No. 4	52	94	282	468
Total horse-power	.....	263	789	1,316

TABLE No. 58.

Discharge Measurements of Valley River, at Valley River, 1912-13.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean Velocity.	Gauge height.	Discharge.
1912.			Feet.	Sq. Ft.	Ft. per sec.	Feet.	Sec.-ft.
Oct. 25	W. G. Worden	1196	57	157·2	2·09	2·94	328
1913.							
Feb. 13	A. Pirie	1462	45	80·0	0·25	2·60	20
April 14	"	1186	157	608·6	3·78	6·17	2300
" 14	"	1186	157	608·1	4·10	6·17	2244
" 14	"	1186	154	585·6	3·71	6·03	2182
June 6	E. Bankson	1469	56	146·8	2·01	2·80	296
" 17	G. Ebner	1186	54	126·9	1·48	2·43	188
July 7	A. Pirie	1496	193	777·9	3·86	7·40	3006
" 11	"	1496	144	525·4	4·11	5·95	2163
Aug. 14	G. Ebner	1196	53	128·0	1·68	2·40	2150
" 22	W. J. Ireland	1469	60	162·7	2·46	2·39	399
Sept. 17	"	1469	52	98·8	1·09	1·80	107
Oct. 14	C. O. Allen	1435	51	84·8	0·82	1·62	69

TABLE No. 59.

DAILY GAUGE HEIGHT AND DISCHARGE, Valley River, at Valley River, 1912.

Day.	October.		November.	
	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1				
2			2·59	
3			2·54	
4			2·50	
5			2·61	
6			2·66	
7			2·64	
8			2·54	
9			2·50	
10			2·47	
11			2·36	
12			2·41	
13			2·51	
14			2·47	
15			2·41	
16			2·34	
17			2·28	
18			2·18	
19			2·14	
20			2·14	
21			2·17	
22			2·32	
23			2·38	
24			2·33	
25	2·94	371	2·26	
26	2·93	367	2·23	
27	2·88	347	2·19	
28	2·79	307	2·09	
29	2·72	286	2·13	
30	2·69	277	2·12	
31	2·67	271	2·09	

TABLE

Daily Gauge Height and Discharge,

Day.	February.		March.		April.		May.		June.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1							3·91	906	2·31	172
2							3·71	786	2·31	172
3					3·54		3·74	804	2·31	172
4					5·32		3·67	762	3·45	630
5					6·02		3·71	786	2·81	319
6			2·61		6·30		3·61	726	2·93	367
7					6·14		4·03	978	2·83	327
8					5·41	1,806	4·03	978	2·24	158
9					4·52	1,272	4·06	996	2·24	158
10					4·44	1,224	3·93	918	2·24	158
11					5·77	2,010	3·94	924	3·04	411
12					5·57	1,890	3·80	840	2·93	367
13	2·60				7·00	2,760	3·46	636	2·81	319
14			2·61		6·01	2,160	3·66	756	2·73	289
15					5·91	2,100	3·71	786	2·51	223
16					5·67	1,950	3·71	786	2·51	223
17					5·71	1,980	3·74	804	2·43	201
18					5·42	1,812	3·53	678	2·58	244
19					5·61	1,920	3·89	894	2·33	178
20	2·61				5·51	1,860	3·60	720	2·30	170
21			2·61		5·31	1,746	3·50	660	2·24	158
22					5·18	1,668	2·61	253	2·20	150
23					5·07	1,602	2·41	197	2·18	146
24					4·71	1,386	2·31	172	2·73	289
25					4·31	1,146	2·31	177	2·71	283
26					3·91	906	2·31	172	2·50	220
27	2·62		2·61		3·51	666	2·31	172	2·50	220
28					3·11	445	2·31	172	2·63	259
29					3·93	918	2·31	172	2·68	274
30					3·81	846	2·31	172	2·60	250
31							2·31	172		

No. 60.

Valley River, at Valley River, for 1913.

July.		August.		September.		October.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
2·74	294	3·11	445	2·05	123	1·55	66	1
3·01	399	3·21	495	1·88	100	1·54	65	2
3·11	445	2·91	359	1·89	101	1·54	65	3
4·91	1,506	2·91	359	1·89	101	1·52	63	4
8·39	3,480	2·71	283	1·87	99	1·50	62	5
7·87	3,270	2·91	359	2·67	271	1·52	63	6
7·40	3,000	2·81	319	2·42	199	1·50	62	7
6·21	2,280	2·76	298	2·27	164	1·49	61	8
5·61	1,920	2·61	253	2·20	150	1·47	59	9
5·51	1,860	2·51	223	2·12	134	1·54	65	10
·95	2,130	2·41	197	2·08	126	1·58	68	11
6·61	2,520	2·36	182	1·91	105	1·55	66	12
8·31	3,540	2·31	172	1·11	38	1·60	70	13
8·20	3,480	2·22	154	1·90	104	1·62	72	14
.....	2,500	2·22	154	1·90	104	1·69	79	15
5·71	1,980	2·22	154	1·84	96	1·63	73	16
5·31	1,746	2·30	170	1·80	92	1·63	73	17
4·81	1,446	2·21	152	1·79	89	1·63	73	18
4·41	1,206	3·11	445	1·76	86	1·68	78	19
4·11	1,026	3·06	419	1·71	81	1·63	73	20
3·81	846	3·01	399	1·60	70	1·60	70	21
3·56	696	2·99	391	1·55	66	1·71	81	22
3·31	550	2·82	323	1·51	63	1·69	79	23
3·01	399	2·70	280	1·60	70	.....	.....	24
2·81	319	2·60	250	1·59	69	.....	.....	25
2·61	253	2·50	220	1·58	68	.....	.....	26
2·41	197	2·20	150	1·59	69	.....	.....	27
2·21	152	1·15	40	1·59	69	.....	.....	28
2·01	119	2·43	201	1·60	70	.....	.....	29
1·81	93	2·22	154	1·60	70	.....	.....	30
1·61	71	2·15	137	.....	.....	.....	.....	31

Mossy River.

A.—LOCATION.

The Mossy river, which rises in lake Dauphin, and is some 21 miles in length, discharges into the southerly end of lake Winnipegosis.

B.—GENERAL DIRECTION.

Heading in the extreme northerly portion of lake Dauphin, the river flows in a westerly course for a distance of two miles. It then bends in a northerly direction, retaining this latter course to the mouth.

C.—RIVER BASIN.

With the exception of the Fork and Fishing rivers, which enter the Mossy from the west, the drainage of the basin is collected by lake Dauphin. Discharging into this lake are the Valley, Turtle, Ochre, Wilson and Vermilion rivers. These rivers, which head in many small lakes and muskegs in the Riding and Duck mountains, flow in a general easterly course to the lake. The upper watershed in the mountains comprises a hilly or rolling country which is well timbered, while the lower and greater portion of the basin is undulating prairie, covered in many places with a growth of willows. In this prairie section, which is very fertile, grain growing and mixed farming are carried on extensively.

D.—NATURE OF BANKS.

The banks of the Mossy vary in height from four to fourteen feet, and are composed of blue or yellow clay overlying a bed of fine gravel. Approximately, 1½ miles above lake Winnipegosis, an outcrop of limestone crosses the bed of the river. Here for a distance of 100 feet along the left bank, a vertical face of rock extends some 6 feet above ordinary stages of river level. Below this outcrop, in the vicinity of the mouth of the river, the banks become low and marshy. At various points along the river, dredged material from the river bed has been dumped along shore, giving an irregular bank.

E.—WIDTH OF RIVER AND NATURE OF BED.

The Mossy river varies in width from 120 to 200 feet, with an average of 160 feet. The bed of the stream is composed of sand and gravel, with numerous boulders occurring in certain localities. The channel has been improved by dredging and by the removal of boulders, practically eliminating all rapids. Due to sand bars, very shallow water occurs at the entrance to the river at lake Dauphin and also at the mouth of the Winnipegosis.

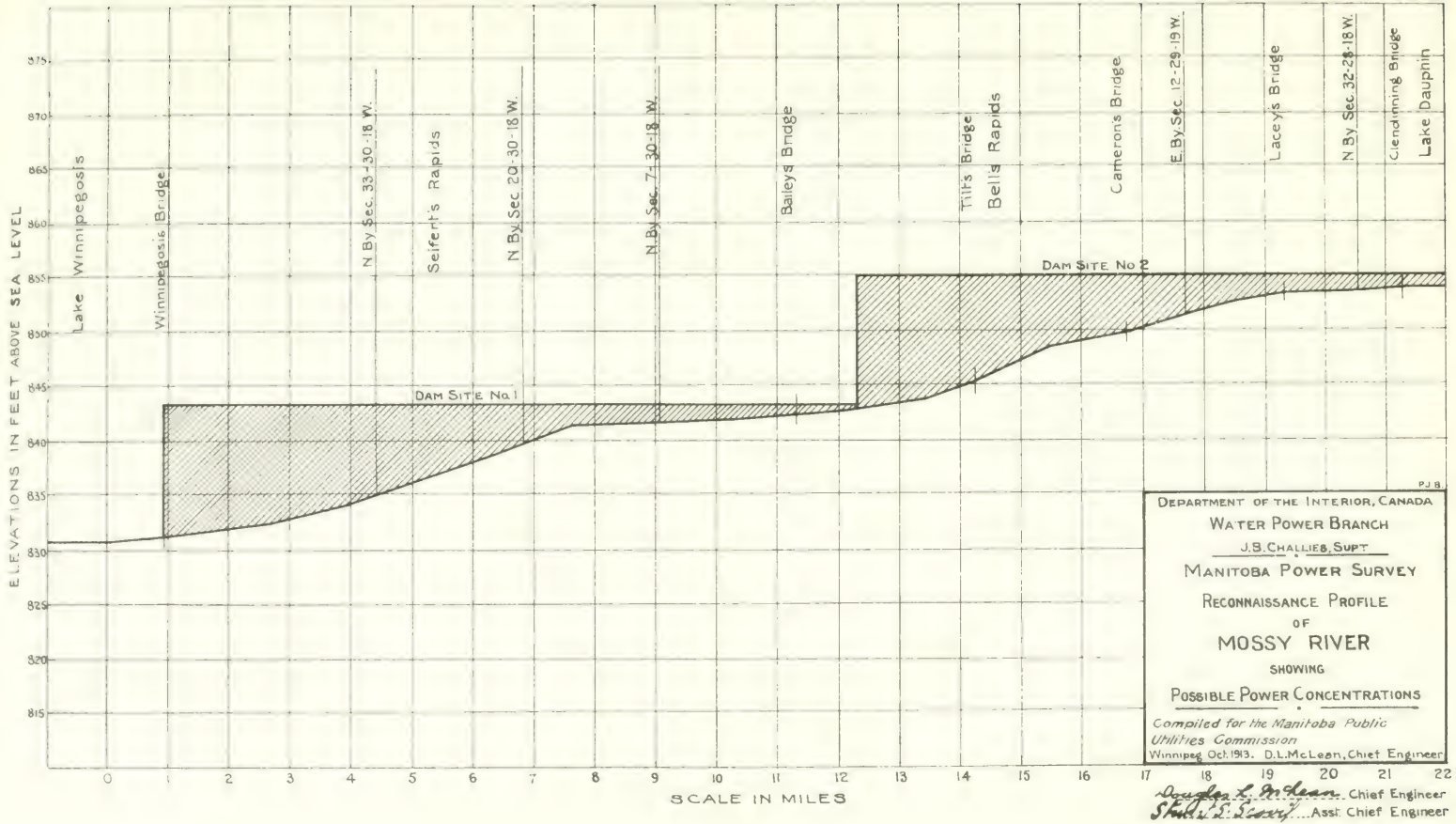
F.—TIMBER AND VEGETATION.

To the west of the Mossy, the land is well settled, and fertile fields devoted to the growth of wheat, oats, barley and root crops border on the river. Farming is not carried on to the same extent east of the river, the greater portion of the land being covered with a growth of willows and poplar.

G.—HIGH AND LOW WATER.

High water usually occurs in April and early May at the time of the spring break-up. Heavy rains in the head-waters also give rise to high water during later periods of the year. It is stated that in the year 1902 extreme high water occurred, being

PLATE 18



P.J.B.

DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
J.B. CHALLIES, SUPT.

MANITOBA POWER SURVEY

RECONNAISSANCE PROFILE
OF
MOSSY RIVER
SHOWING
POSSIBLE POWER CONCENTRATIONS

Compiled for the Manitoba Public Utilities Commission
Winnipeg Oct. 1913. D.L. McLean, Chief Engineer

Douglas L. McLean ... Chief Engineer
Stuart S. Scarry ... Asst. Chief Engineer

some six feet higher than the ordinary stages of the river level. In July, 1913, the water was again high, due to prolonged heavy rains, but did not reach within 4 feet of the extreme of 1902. Low water usually occurs in February.

H.—ICE CONDITIONS.

It is stated locally that for the first three miles below lake Dauphin the river does not freeze over in winter, but lower down the surface freezes, in some places to a depth of two feet or more. It is also reported that since the improvements to the river channel, the ice breaks up in the spring without the formation of ice jams.

I.—ACCESSIBILITY AND NAVIGATION.

Winnipegosis, the terminus of the Winnipegosis branch of the Canadian Northern railway, is situated at the mouth of the river. Southerly from this town for a distance of 14 miles to Fork river, the railway is never more distant than 1½ miles from the river. Some six bridges, which are accessible by numerous roads, cross the river at various points. The stream itself is navigable for small crafts, but is not now used for transportation.

J.—SETTLEMENTS.

As stated previously, the adjacent country is a well-settled agricultural district. The town of Winnipegosis, which has a population of some six hundred people, is situated at the mouth of the river, while the town of Dauphin, which is the central point of the district, is only some 40 miles distant therefrom.

K.—SURVEYS.

A geological reconnaissance of the river and tributary country was made in the year 1889 by the Dominion Geological Survey. During the years 1887 to 1898, the country was subdivided by Dominion Land Survey, and opened up for settlement. With a view to lowering lake Dauphin by dredging the river channel, the Dominion Department of Public Works made a survey of the river in 1908 and, in the four following years, dredging was proceeded with. In 1905, D. A. Keizer, C.E., surveyed and reported on a possible power site situated one-half mile above the town of Winnipegosis. During the summer of 1913, a reconnaissance investigation of the power possibilities of the river was made by a field party of the Manitoba Power Survey.

L.—RUN-OFF.

(*a*) *Precipitation.*—Although no records of precipitation of sufficient period are available for the district, it is estimated that the mean annual rainfall is approximately 18 inches, the estimate being based on records in adjoining drainage basins of practically the same physical features.

(*b*) *Discharge Measurements.*—On July 14, 1913, a gauging station was established on the river one-half mile below the entrance of the Fishing river. Results of meterings taken at this section, together with an estimate of daily discharge from July 14, 1913, are given in tables No. 61 and No. 62.

M.—STORAGE POSSIBILITIES.

Lake Dauphin, with an area of 196 square miles, is practically the collecting basin of all drainage carried by the Mossy. Preliminary investigations indicate that it would be possible to obtain a 3-foot storage on this lake. At the same time it would be

necessary to consider the effect of any such storage on certain low-lying lands bordering on the lake. The dredging and improvements to the river channel during past years were carried on with the object of lowering the level of lake Dauphin and giving better drainage to such low lands. While the effects of possible drainage are not dealt with in this report, the following table gives an estimate of the flow available from storage on the lake, under the following headings: (*a*) The capacity of reservoir per foot depth of storage; (*b*) the rate of draft available for a storage extending over a period of six months; (*c*) the rate of draft available for a storage extending over one year:—

Depth of Storage.	Storage in millions of cu. ft.	Flow in cu. ft. per second.	
		Period 6 mos.	Period 1 year.
	(*a*)	(*b*)	(*c*)
1 foot	5464	346	173
2 "	10928	692	346

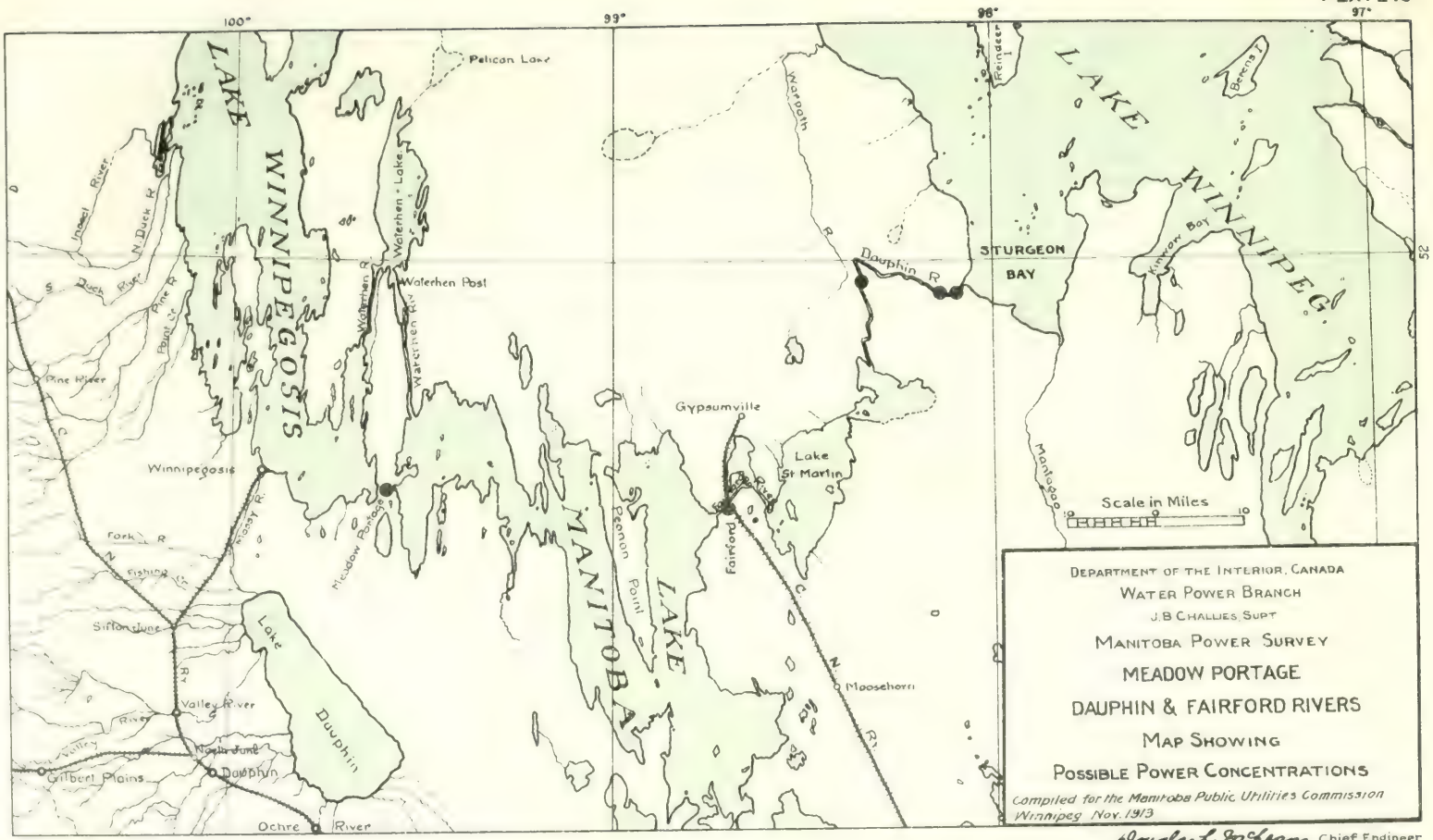
N.—POWER POSSIBILITIES.

While the records of stream measurements for this river do not at present extend over sufficient period to define the minimum flow, it is estimated that the minimum flow is approximately 500 second-feet, this estimate being based on gauge records obtained during the winter of 1911-12 by the Department of Public Works, at a point approximately one mile upstream from the Manitoba Hydrographic gauging station. Using this amount, which is subject to verification or revision as future records are obtained, the following table gives the estimated available horse-power at two possible power sites as shown on profile plate No. 18. In the results, as given, the power has been based on an 80 per cent turbine efficiency. No estimate is made as to the additional power available through a regulation of the flow of the river, although the same would greatly increase the power possibilities:—

Power Site.	Head.	Estimated Horse-power, based on 80 per cent efficiency and a minimum flow of 500 second-feet.
No. 1	10	455
No. 2	10	455
Total horse power		910

Mossy River. Bell's Rapids
from above
Aug. 18th. 1913.

PLATE 19



DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
J.B. CHALLIES, SUPT

MANITOBA POWER SURVEY

MEADOW PORTAGE
DAUPHIN & FAIRFORD RIVERS

MAP SHOWING

POSSIBLE POWER CONCENTRATIONS

Compiled for the Manitoba Public Utilities Commission
Winnipeg Nov. 1913

Douglas L. McLean ... Chief Engineer
Frank S. Scott ... Asst. Chief Engineer

TABLE No. 61.

DISCHARGE MEASUREMENTS of Mossy River, below Fishing River (Lacey's), 1913.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean Velocity.	Gauge height.	Discharge.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
July 14	A. Pirie	1496	131·5	591·6	2·80	3·66	1658·1
Aug. 11	D. B. Gow	1187	128·0	485·0	2·64	3·83	1280·4
" 19	D. B. Gow	1187	140·0	651·0	1·83	2·63	1191·3[1]
" 23	W. J. Ireland	1469	115·8	452·3	2·54	2·68	1151·3
Nov. 11	C. O. Allen	1374	103	229	2·31	1·59	666

[1] Metered two miles below regular section.

TABLE No. 62.

DAILY GAUGE HEIGHT AND DISCHARGE, Mossy River, near Fishing River, for 1913.

Day.	JULY.		AUGUST.		SEPTEMBER.		OCTOBER.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	.....	3·20	1435	2·55	1105	2·05	868
2	.....	.....	3·20	1435	2·53	1095	2·05	868
3	.....	.....	3·20	1435	2·50	1080	2·03	859
4	.....	.....	3·30	1490	2·50	1080	1·87	788
5	.....	.....	3·10	1380	2·50	1080	1·90	800
6	.....	.....	3·10	1380	2·51	1085	1·90	800
7	.....	.....	3·00	1330	2·50	1080	1·85	780
8	.....	.....	2·90	1280	2·50	1080	1·85	780
9	.....	.....	2·90	1280	2·30	980	1·86	784
10	.....	.....	2·50	1080	2·20	935	1·30	560
11	.....	.....	2·50	1080	2·20	935	1·60	680
12	.....	.....	2·50	1080	2·21	940	1·65	700
13	.....	.....	2·50	1080	2·23	949	1·64	696
14	3·70	1710	2·80	1230	2·20	935	1·59	676
15	3·60	1655	2·70	1180	2·20	935	1·63	692
16	3·60	1655	2·70	1180	2·19	931	1·63	692
17	3·50	1600	2·67	1165	2·10	890	1·70	720
18	3·50	1600	2·66	1160	2·15	913	1·70	720
19	3·50	1600	2·68	1170	0·63	329	1·70	720
20	3·40	1545	2·67	1165	1·15	498	1·70	720
21	3·40	1545	2·66	1160	1·90	800	1·65	700
22	3·30	1490	2·67	1165	2·00	845	1·70	720
23	3·30	1490	2·67	1165	2·20	935	1·70	720
24	3·30	1490	2·65	1155	2·20	935	1·70	720
25	3·30	1490	2·65	1155	2·10	890	1·70	720
26	3·30	1490	2·65	1155	2·05	868	1·70	720
27	3·20	1435	2·65	1155	2·07	876	0·90	410
28	3·20	1435	2·63	1145	2·00	845	0·90	410
29	3·40	1545	2·63	1145	2·00	845	1·10	480
30	3·20	1435	2·63	1145	2·00	845	1·10	480
31	3·20	1435	2·50	1080	.....	.....	1·13	491

WATERHEN RIVER AND MEADOW PORTAGE.

Waterhen River.

A.—LOCATION.

The Waterhen river, plate No. 19, flows out of lake Winnipegosis at its southerly end, and discharges into the northerly end of lake Manitoba.

B.—GENERAL DIRECTION.

Heading in Long reach of lake Winnipegosis, the river flows in two distinct channels in a northerly direction a distance of some 8 miles, and enters Waterhen lake; passing through this lake the river flows in a southerly direction some 18 miles before emptying into lake Manitoba.

C.—RIVER BASIN.

The drainage basin of the Waterhen river, which has an area of 21,200 square miles at the outlet of lake Winnipegosis, comprises that portion of Manitoba lying between the above lake and the highlands of the Porcupine, Riding and Duck mountains. Westward, from lake Winnipegosis to the mountains, the basin is a slightly undulating plain with a gentle upward slope which, for the most part, has an overlying soil of clay, through which occasional rock outcrops occur. In the vicinity of the mountains the country becomes rugged and rises very abruptly. This upper land in which lie the head-waters of the drainage is, to a great extent, covered with a timber growth of pine and spruce. The main streams tributary to lake Winnipegosis heading in this district are the Red Deer, Swan and Valley rivers. While several large lakes such as lakes Winnipegosis, Red Deer, Swan and Dauphin are situated in the lower portion of the drainage, yet lakes occurring in the head-waters, though numerous are exceedingly small in size.

D.—RIVER CHANNEL.

From lake Winnipegosis to Waterhen lake there are two distinct river channels; a smaller channel heads in the lakes some six miles south of the main river and has a course parallel to the latter with an intervening space varying in width from one-half mile to a mile. At a mile from the source of the main river a cross channel flows from it to the smaller stream. Below this there is no connection between the two rivers until Waterhen lake is reached; from this lake to lake Manitoba the river flows in one channel only.

E.—NATURE OF BANKS.

In both the upper channels the river flows between low marshy banks which extend back some 1,200 feet before the timber line is reached. Where this growth occurs, the banks reach an average elevation of from three to four feet above the ordinary stages of river level. Great portions of the intervening space between river and timber line are covered with water, and growths of reeds extend far out into the river itself. The soil, to a depth of one foot, is light and sandy, but underlying this is a strata of light blue clay mixed with gravel. From Waterhen lake to within a few miles of lake Manitoba, the banks are slightly higher and drier and, from surface indications, are composed of the same soil. In the vicinity of lake Manitoba the banks again become low and marshy.

F.—WIDTH OF RIVER AND NATURE OF THE BED.

The width of the main Waterhen river averages about 600 feet, with the exception of the portion in the vicinity of the lakes where the width increases to approxi-

mately a mile. The smaller channel, or Little Waterhen, has an average width of some 200 feet. The bottom of both rivers is composed of gravel strewn in some places with large boulders which, in the reach of the river below Waterhen lake, make navigation very difficult.

G.—TIMBER AND VEGETATION.

Hay meadow land borders the river for almost its entire length, but very little hay is cut, due to the extreme wetness of the land. Timber is plentiful but consists almost entirely of poplar, with a sprinkling of spruce and birch. At the Waterhen Trading post on Waterhen lake, root crops are grown for local consumption.

H.—RUN-OFF.

(*a*) *Precipitation.*—No definite information relating to precipitation is available for this whole drainage basin. Records at Russell and Minnedosa, which are situated slightly to the south of the drainage basin, show a mean annual precipitation at Russell of 16·4 inches for a period of nine years, and a mean annual precipitation of 17·8 inches at Minnedosa for a period of 32 years. As somewhat similar physical conditions apply both to the upper drainage of the Waterhen and to these two points, it may be assumed that the precipitation is of like amount.

(*b*) *Discharge Measurements.*—In the summer of 1881, a discharge measurement of the Waterhen river was made by Thomas Guerin, C.E. No further measurements appear to have been made until 1913, when a metering was made by the Manitoba Hydrographic Survey at a section below Waterhen lake, showing a discharge of 8474 second-feet, table No. 63. Owing to the inaccessibility of this portion of the river, no regular gauging station has been maintained. In the absence of more reliable data, an estimated low flow of 5,000 second-feet has been based on measurements made on the Fairford river during 1912-13 by the Manitoba Hydrographic Survey. While this estimate is used for computing the power possibilities, it should be borne in mind that the flow given is purely an estimate, and is subject to revision.

I.—MEADOW PORTAGE AND POWER POSSIBILITIES.

As a power possibility in itself, the Waterhen river does not offer any very attractive features, but rather by the diversion of its waters across the narrow neck of land separating lake Winnipegosis from lake Manitoba. This strip of land, lying at the southwest corner of the former lake, has, at its narrowest part in the vicinity of Meadow Portage, a width of some 9,400 feet. The summit elevation is approximately six feet above lake Winnipegosis, and the surface soil is composed of a light grey calcareous clay, holding many pebbles of limestone. From investigations made at the summit, hard-pan occurs at a depth of four feet, while adjacent to the lakes clay constitutes the underlying soil.

At various times the construction of a canal between the two lakes has been advocated for navigation purposes and, were this undertaking proceeded with, the development of power in conjunction with the canal would be an important factor.

J.—TRANSPORTATION AND ACCESSIBILITY.

The Waterhen river and Mossy Portage are both accessible in summer by boat from the town of Winnipegosis, which is situated at the southern end of lake Winnipegosis. The distance from this latter place by water is some 22 miles to the river and 15 miles to the portage. A wagon road also leads from the town to the portage. The Waterhen river is navigable for boats of shallow draught, but, below Waterhen lake, navigation is difficult, due to boulders in the river bed and to submerged vegetation.

K.—SETTLEMENTS.

Outside the Waterhen Indian Reserve, which lies to the north of Meadow Portage, and between the upper and lower branches of the Waterhen, no settlements of any size are situated in the immediate vicinity. Land surrounding the Meadow Portage has been subdivided and is partially settled.

L.—SURVEYS OF WATERHEN RIVER AND MEADOW PORTAGE.

The country in the vicinity of Meadow Portage has been subdivided by Dominion Land Survey. In 1889 the Geological Survey of Canada made a geological survey of the district, including the Waterhen river. A survey of Meadow Portage was made slightly previous to the year 1909 by the Dominion Department of Public Works, while in the year 1909 further investigations were carried on by the same department. In the summer of 1913 a reconnaissance survey of Meadow Portage was made by the Manitoba Power Survey, with Mr. D. B. Gow in charge of the field party. At the same time, investigations were made as to the location of dam sites on the upper Waterhen rivers, as it would be necessary to divert the waters from this outlet for any complete development in the vicinity of Meadow Portage.

M.—HEAD AVAILABLE.

The difference in elevation between the two lakes on August 26, 1913, as determined by the Manitoba Power Survey, was 18·6 feet. The water in both lakes at the time was stated locally to be at a high stage. As published in the Geological Survey Report of 1889-91, the difference in elevation in 1873 was found by Mr. H. B. Smith, C. E., to be 18·73 feet, and later, in 1889, a determination of 17·4 feet was made by G. A. Bayre, C.E.

Due to storms on the lakes, considerable variation in this drop is quite probable. It is stated that a severe storm from the northwest is capable of raising the waters at the southerly end of the lake Winnipegosis to an extent of three feet. Evidences of such an effect were noted, after a severe storm, by the Manitoba Power Survey. At the same time, a lowering of the northern waters of lake Manitoba occurs, but of a decidedly smaller range than in the upper lake.

N.—WATER-POWER.

As stated previously, a low flow of 5,000 second-feet has been assumed for the Waterhen river. This, together with an approximate head of 15 feet (both of which figures are subject to revision) would, on a basis of 80 per cent efficiency, show a power possibility of 6,807 horse-power.

O.—STORAGE POSSIBILITIES.

Lake Winnipegosis, which acts as the collecting basin for the entire drainage area, offers immense storage possibilities. It has an area, exclusive of islands, of some 2,000 square miles. While storage would be possible on this lake, the effect of any raising of the waters would have to be considered with reference to any low-lying areas bordering on the lake. The following table has been computed in order to show the possibilities of additional flow and power from such storage under the following headings: (*a*) the flow in cubic feet per second for a storage utilized in a period of six months; (*b*) the power available from this flow based on a 15 foot head at 80 per

Water H. Rivers — Typical View of Upper Main River.

Little Waterhen River — Typical view of Water channel.

Meander Portage

Meadow Portage - Shore line - Lake Winnipegosis side

Meadow Portage - Typical hay meadow, flooded by waves from Lake Winnipegosis in big storms

cent efficiency; (*c*) the flow in cubic feet per second for a storage utilized in a period of a year; (*d*) the power available based on the same conditions as in (*b*).

Depth of Storage in Feet.	Flow in Sec.-ft. for 6 months.	Horse-power.	Flow in Sec.-ft., 1 year.	Horse-power.
	(*a*)	(*b*)	(*c*)	(*d*)
1	3,536	4,814	1,768	2,407
2	7,072	9,628	3,536	4,814

TABLE No. 63.

Discharge Measurement of Waterhen River, four miles from Lake Manitoba, 1913.

Date.	Hydrographer.	Meter No.	Width.	Area of Section.	Mean Velocity.	Gauge Height.	Discharge
1913.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft,
Aug. 22	D. B. Gow	1187	439	3038	279	.....	8474

Fairford and Dauphin Rivers.

A.—LOCATION AND GENERAL DIRECTION.

The Fairford and Dauphin rivers (*see* plate No. 19), form the connection between lake Manitoba and lake Winnipeg. Heading in lake Manitoba at almost the extreme northeasterly corner, the Fairford river flows in a northeasterly direction and enters the westerly end of lake St. Martin. This latter lake is discharged by the Dauphin river which heads in the northeast corner of the lake, and flows almost due north for a distance of 14 miles. A sharp bend to the east then occurs in the river and this latter course is held throughout to the mouth, which enters Sturgeon bay on the west shore of lake Winnipeg.

B.—RIVER BASIN.

Lake Manitoba, with an area of 1,711 square miles, acts as a collecting basin for practically all the drainage carried by this system of rivers. In general terms, the area drained is that land lying to the east of the Manitoba escarpment, together with those portions of the plains tributary to the Swan and Red Deer rivers. While the upper reaches of the watershed extend into the Riding, Duck and Porcupine mountains, where the country is hilly and to a great extent covered by a forest growth, yet the greater portion of the area is a slightly undulating prairie. The soil for the most part is an agricultural clay overlying beds of gravel, with occasional rock outcrops. Numerous lakes occurring in the drainage vary in size from mere ponds to lakes of great extent, such as lakes Winnipegosis and Manitoba. In the mountain district, the lakes, though numerous, are small in size. In the central portion of the basin three larger lakes occur, lake Dauphin with an area of 196 square miles, Swan lake with an area of 121 square miles, and Red Deer lake of some 100 square miles. These latter lakes, together with many streams, empty into lake Winnipegosis which has an area of 2,000 square miles. The Waterhen river, forming the connecting link in the drainage system between lake Winnipegosis and lake Manitoba, flows in a 'V' shaped

course across a narrow neck of land separating these two lakes. While considerable adjacent territory drains into lake Manitoba, yet the only other tributary of any size is the Whitemud river. From the outlet of the lake to the mouth of the Dauphin river in Sturgeon bay, no streams of any extent are tributary to the river system.

C.—NATURE OF BANKS.

For the first three miles the banks of the Fairford river are well defined, varying from 3 to 10 feet in height, reaching a maximum in the immediate vicinity of the C.N.R. bridge at Fairford station. Below this point the banks become gradually lower, opening out into a wide expanse of low marshy land, which merges into a stretch of water known as lake Pinemuta. After leaving this lake, the banks range from 2 to 3 feet in height, but again merge into swampy shores as lake St. Martin is approached. Throughout, the banks are composed of light grey clay, in which a few boulders are imbedded. Where the Dauphin river leaves lake St. Martin, the banks are poorly defined, low-lying meadows, subject to overflow in periods of high water, merge into the timber line about one-half mile from the other side of the channel. The banks, which are composed of sandy clay and which vary in height from one-half foot to two feet, present this same general appearance for the first 11 miles of river; at this distance from the lake, the river cuts through a sandy ridge running in an east-and-west direction, and of a maximum height of some 8 feet. For the following 12 miles, to a point on the river where rapids occur, the banks become higher, ranging from 1 to 6 feet in height, though in many places giving way to swampy indentations. From the rapids to Sturgeon bay there is a range of from 5 to 32 feet. At numerous places in this lower reach, limestone ridges cross the bed of the river, and rock outcrops are visible in the sandy soil of the banks.

D.—WIDTH OF RIVER AND NATURE OF BOTTOM.

The Fairford river varies in width from 500 to 900 feet. It is stated that the river is shallow in the vicinity of lake Manitoba, where it flows over a bed of limestone. About one-half mile below this a small rapids is caused by a bed of limestone and gneiss boulders; this same feature is also noticeable in the lower portion of the river.

The Dauphin river, which has an average width of 450 feet, is in places slightly narower than the Fairford. The river bed for the first 11 miles is sandy and seemingly free from large boulders, but below this gravel bars and boulder-strewn bottom are encountered, both of which give rise to numerous rapids. Outcroppings of limestone are also found in this lower reach of the river.

E.—TIMBER AND VEGETATION.

The Fairford Indian reserve borders on the Fairford river, and the banks for a short distance in the immediate vicinity have been cleared of timber. Beyond this is a thick growth of poplar.

Along the Dauphin river the greater portion of the land is covered with a dense growth of poplar, spruce, maple, oak and birch, yet at the same time large areas of low-lying swamp land and hay meadows are scattered throughout the course of the river. With the exception of some fields devoted to root crops along the Fairford river, farming is not carried on to any extent in this district.

F.—HIGH AND LOW WATER.

High water usually comes in the latter part of April and the early part of May, while February is the month of low water. The range in river level between these

two periods is ordinarily some 4 feet. An extreme range of some 8 feet was noted in the year 1902.

G.—ICE CONDITIONS.

It is stated that for the first three miles, the Fairford river does not freeze over in winter, but below this an ice cover forms. The statement is also made that during the spring break-up on the Fairford the ice passes away freely without formations of jams or of destruction to the banks, while severe jams do occur on the Dauphin river at the rapids near Sturgeon bay. It is claimed that the jams at this point have caused a rise of from 15 to 20 feet above ordinary summer stages. Evidence of such an occurrence was noted by a field party of the Manitoba Power Survey, boulders, logs and driftwood being found fully 20 feet above the water level of September, 1913.

H.—TRANSPORTATION AND ACCESSIBILITY.

The Fairford river is navigable for small steamers, though it is claimed that difficulty occurs near lake Manitoba, due to bars.

Navigation on the Dauphin river is also possible for small steamers in early summer, but according to local information the river is treacherous, due to continual change of channel. The only point at which the river system is accessible by railroad is at Fairford, where the C. N. Ry. have a bridge spanning the river.

While no railroad lies in the immediate vicinity of the Dauphin river, yet steamers plying on lake Winnipeg navigate to the mouth of the river in Sturgeon bay.

I.—SETTLEMENTS.

Outside of the settlements in the Indian reserve, only two settlements are located in the district, one of those being at Fairford, which is one-half mile from the C.N.R. crossing of the Fairford river, and the other settlement is at Sturgon bay. At this latter place a fish hatchery was constructed by the Department of Marine and Fisheries during the year 1913.

J.—SURVEYS.

A geological reconnaissance was made of the rivers in 1889 and 1890 by the Geological Survey of Canada. Surveys at the Indian reserve on the Fairford river have also been made by the Department of Indian Affairs.

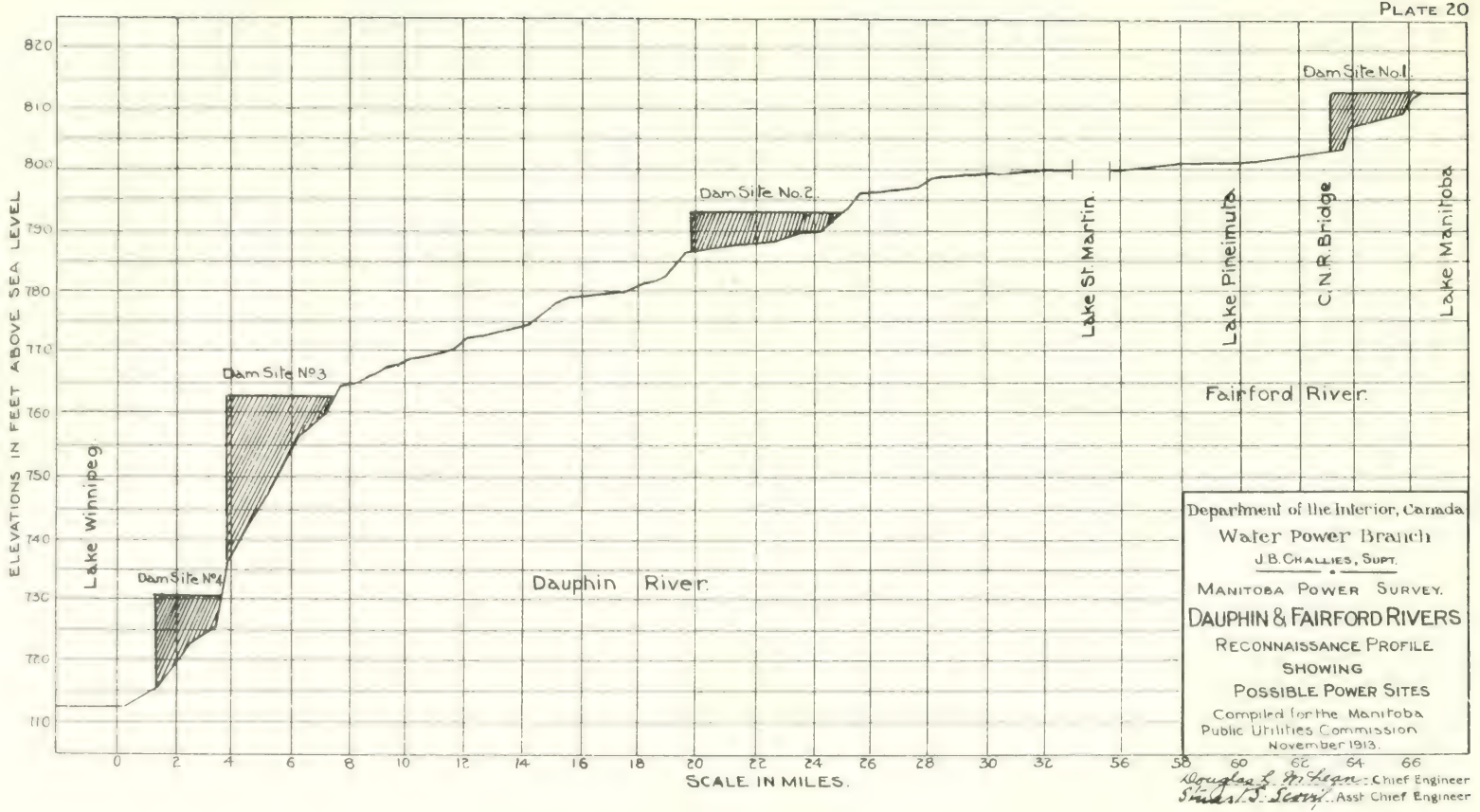
In order to secure data for the improvement of navigation on the Fairford river, surveys extending over the years 1898, 1908, 1910 and 1913 have been made by the Dominion Department of Public Works. In September and October, 1913, a reconnaissance survey of the power possibilities of the river system was made by a field party of the Manitoba Power Survey operating under the direction of the Water-power Branch of the Department of the Interior. A profile of the river, together with investigations of possible power concentrations, were made by this party.

K.—RUN-OFF.

(*a*) *Rainfall.*—Rainfall in this drainage basin is estimated to be a mean of some 18 or 19 inches per annum. Records of very short term have been made of some few places in the district, and on these the above estimate has been based.

(*b*) *Discharge Measurements.*—Discharge measurements by the Manitoba Hydrographic Survey have been made since June 28, 1912, at the C.N.R. bridge crossing

PLATE 20



Department of the Interior, Canada
Water Power Branch
J.B. CHALLIES, SUPT.

MANITOBA POWER SURVEY.

DAUPHIN & FAIRFORD RIVERS

RECONNAISSANCE PROFILE
SHOWING
POSSIBLE POWER SITES

Compiled for the Manitoba
Public Utilities Commission
November 1913.

Douglas L. McLean: Chief Engineer
Stuart J. Scott: Asst. Chief Engineer

the Fairford river near Fairford post office, the results of these measurements being given in table No. 64. Due to changes in the river channel, such as the building of coffer dams and piers at the above bridge, a regular station could not be established, as the above obstructions caused such extreme ranges in gauge heights that no rating of the station was possible. The bridge was completed in the fall of 1913, and on October 30 a gauging station was established. Data is now being obtained so that a complete record of the daily flow from this latter data will be available.

From the results of the above measurements, low flow of 5,000 second-feet has been estimated for the winter of 1912-13. While this flow is being used for the computation of possible power, yet it should be borne in mind that, being an estimate, it is subject to revision when more complete data are obtained.

L.—STORAGE POSSIBILITIES.

Containing, as it does, an immense lake area in the lower reaches of the watershed, it should be possible to obtain practically a complete regulation of the flow. An estimate of the storage possibilities on lake Winnipegosis, and the resulting increase in flow during low periods, has already been made in chapter VIII, with relation to the Waterhen river and Meadow Portage.

Lake Manitoba is said to ordinarily vary one foot above and one foot below its mean level, giving in all a range of two feet. Assuming that such a range for storage purposes could be utilized, the following table gives the various rates of draft available from such a storage completely used in a period of either 3 months, 6 months, or a year:—

Depth of Storage.	Storage in Millions of cu. ft	Rate of Draft in Second Feet.		
		Period 3 Months.	Period 6 Months.	Period 1 Year.
1 foot	47·7	6048	3024	1512
2 "	95·4	12096	6048	3024

M.—WATER-POWER.

Possible power concentration on the rivers are shown on the profile on plate No. 20. An estimate of the power available at these sites is given in the following table. The power has been computed at 80 per cent efficiency on an estimated low flow of 5,000 second-feet, no estimate having been made as to the additional power available through storage:—

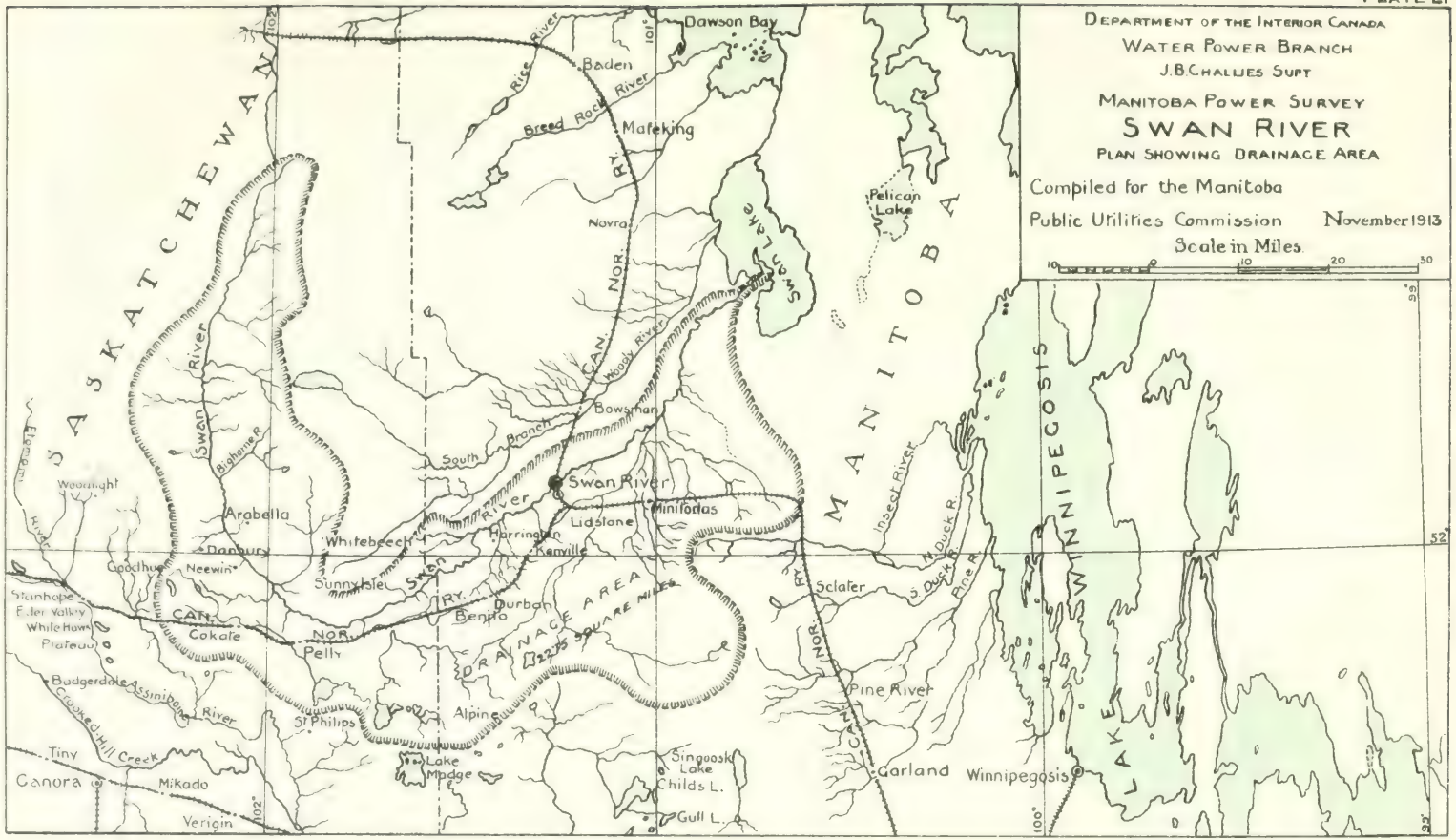
Power Site.	Head in Feet.	Estimated Horsepower at 80 per cent Efficiency, Low Flow of 5,000 Second feet.
No. 1	8	36330
No. 2	6·5	2950
No. 3	28	12706
No. 4	16	7260
Total horse power		26546

Fairford River – C.N.R. bridge, Fairford, from above

Steamer going down River

Dauphin River - Rapids - Exit to Sturgeon Bay

Dauphin River - Rapids - Typical view below Rapids.



Douglas L. McLean Chief Engineer

Stuart J. Scott Asst Chief Engineer

TABLE No. 64.

DISCHARGE MEASUREMENTS of Fairford River, at Fairford, 1913.

Date.	Hydrographer.	Meter No.	Width.	Area of Section.	Mean Velocity.	Gauge Height.	Discharge
			Feet.	Sq. ft.	Ft per sec	Feet.	Sec.-ft.
June 28..	G. H. Burnham	1187	293	1919	4·08	7·82	7849
July 31..	G. H. Burnham	1187	269	1716	4·01	7·48	6897
Aug. 29..	Alex. Pirie	1197	279	1720	4·88	7·60	8341
Oct. 11..	R. H. Nelson	1187	280	1616	4·38	7·52	7083
Dec. 6..	G. J. Lamb	1187	308	1966	4·52	9·60	8886
Apr. 24..	E. Bankson	1469	283	1572	4·68	7·33	7345
May 15.	G. Ebner	1186	320	1647	4·57	7·56	7527
Aug. 14..	C. O. Allen	3	253	1824	4·10	7·50	7475

SWAN RIVER.

A.—LOCATION.

The Swan river (*See* plate No. 21), situated in central western Manitoba, rises to the west of the Porcupine mountain, and, flowing in the valley between the Porcupine and Duck mountains, discharges into Swan lake.

B.—GENERAL DIRECTION.

Heading in township 42 along the second meridian, the river flows in a southerly direction a distance of 50 miles. Here the river bends to the northeast, continuing this latter course to its mouth.

C.—RIVER BASIN.

The Swan river flows in a wide, deep valley, lying between the Duck and Porcupine mountains. In the lower portion of the watershed from Swan lake to the point at which the river loops around the Porcupine mountains, practically all drainage enter from the south. Many small tributaries heading in the Duck mountains enter from that direction. To the north of this portion of the river the drainage area is confined by the Woody river, which has a parallel course to that of the Swan. Above the bend or loop, the basin widens out, with many small tributaries entering from the east and west. Many springs are stated to exist in the vicinity of the river, but the lakes of the basin are both small and few in number.

D.—NATURE OF BED AND BANKS.

The valley and the banks of the river are to a great extent composed of a deposit of alluvial sand or clay. In the upper portion of the valley it is stated that outcroppings of grey clay shale and sandstone occur along the river. The latter has an average width of 150 feet, with banks ranging from ten to fifty feet in height, and a bed reported to be composed of gravel and clay, with the occurrence of boulders at many points.

E.—TIMBER AND VEGETATION.

In many portions of the mountain country there is an overgrowth of timber, while in the Swan River valley the country is more open. On the rich meadow land of this district, grain growing and farming are carried on extensively.

F.—HIGH AND LOW WATER.

The latter part of April is usually the period of high water, while February is the low-water month. In the year 1913, a range of some 4 feet was recorded between the two extremes.

G.—TRANSPORTATION.

Due to many beds of boulders in the river, navigation is impossible. The river is accessible, however, by old trails, and is also crossed by the Canadian Northern railway at the town of Swan River. A branch line of this railway parallels the course of the river for a considerable distance above the town.

H.—SETTLEMENTS.

The country is essentially an agricultural district, and is well settled. The town of Swan River, which is the commercial centre, is the most important settlement, though many smaller settlements occur throughout the district.

I.—SURVEYS OF THE RIVER.

The Geological Survey of Canada made a geological survey of the river and the surrounding territory in the year 1889.

In the year 1909, Messrs. Pratt and Ross, hydraulic engineers, investigated the power possibilities of the river in the vicinity of the town of Swan River, and reported upon a possible power development. A gauging station was later established on the river on October 24, 1912, by the Manitoba Hydropraphic Survey.

J.—RUN-OFF.

(*a*) *Precipitation.*—No complete records of precipitation are available for this basin, but it is estimated that the annual mean is some nineteen inches.

(*b*) *Discharge Measurements.*—Discharge measurements have been made by the Manitoba Hydrographic Survey near the town of Swan River since October 24, 1912, the results of this work being given in table No. 65. As shown by the estimated daily discharges in tables No. 66 and No. 67 the minimum flow for the year 1913 to October 31, was 50 second-feet, while a flood discharge during the same period amounted to 4,800 second-feet.

K.—WATER-POWER.

No field survey has been made of the power possibilities of the river though it is known that considerable fall does occur throughout the extent of the river. At the junction of Snake creek with the Swan river, some 18 miles west of the Manitoba boundary, the elevation of the river bed, as obtained from preliminary lines of the Canadian Pacific railway, is 1,390 feet above sea-level, while Swan lake is at an elevation of 855 feet. This would indicate a drop of 535 feet in an approximate distance of 100 miles of river. In 1909, Messrs. Pratt and Ross reported on a possible power concentration of some 14 feet head in the vicinity of the town of Swan River. Based on the estimates of flow for the year ending October 31, 1913, the fol-

C. 1077
Swan River
Looking downstream from Metering Station

lowing table gives the power available per foot head at an 80 per cent efficiency, and is computed for a low flow of 50 second-feet, and also for the lowest monthly mean flow (160 second-feet) for the period of 7 months from April to October. In this latter case, the estimated power only relates to the periods as stated above:—

Head in Feet.	Estimated Horse—Power at 80 per cent Efficiency.	
	Minimum Flow, 50 sec.-feet.	Flow 160 sec.-feet. Period, April to Oct.
1	4·5	14·5
10	45	145
20	90	290

TABLE No. 65.

Discharge Measurements of Swan River, at Swan River, Man., 1912-13.

Date.	Hydrographer.	Meter No.	Width.	Area of Section.	Mean Velocity.	Gauge Height.	Discharge.
1912.			Feet.	Sq. feet.	Ft. per sec.	Feet.	Sec.-feet.
Oct. 24.	W. G. Worden	1196	138	404	2·51	2·55	1613
Dec. 11.	G. Lamb	1187	101	177	·72	1·43	125[1]
1913.							
Feb. 12.	A. Pirie	1469	105	54	1·00	1·31	54[1]
April 12	"	.....	150	...	...	4·12	4055
April 13	"	1186	150	781	5·27	4·96	4118
April 13	"	1186	150	781	5·44	4·96	4251
June 5.	E. Bankson	1469	138	587	1·50	1·93	583
June 17.	G. Ebner	1186	133	324	1·24	1·51	401
July 8.	A. Pirie	1496	144	674	3·88	4·01	2618
Aug. 13.	G. Ebner	1196	140	341	1·25	1·64	428
Aug. 26.	W. J. Ireland	1469	137	357	1·35	1·94	490
Sept. 1.	"	1469	137	307	1·03	1·47	316
Sept. 23	"	1469	122	251	·62	0·98	155
Oct. 13.	C. O. Allen	1435	123	258	·65	1·09	167

1. Ice measurements.

TABLE No. 66.

DAILY GAUGE HEIGHT AND DISCHARGE, SWAN RIVER, NEAR SWAN RIVER, MAN., FOR 1912.

[Drainage area, 1,215 square miles.]

Day	October.		November.		December.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			2·13	716		
2			1·96	560		
3			1·73	462		
4			1·71	451		
5			1·71	451		
6			1·72	456		
7			1·73	462		
8			1·72	456		
9			1·71	451		
10			1·71	451		
11			1·70	445	1·43	1·25
12			1·70	445		
13			1·69	440		
14			1·69	440		
15			1·69	440		
16			1·68	435		
17						
18						
19					1·23	
20						
21						
22						
23						
24	2·56	1041				
25	2·55	1033				
26	2·51	999				
27	2·42	926				
28	2·35	873			1·23	
29	2·34	865				
30	2·28	821				
31	2·25	800				

TABLE

DAILY GAUGE HEIGHT AND DISCHARGE, Swan

[Drainage area,

Day.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1									2·50	990
2									2·45	950
3									2·40	910
4			1·33						2·33	858
5							2·40		2·42	926
6									2·71	1169
7									2·87	1317
8									2·86	1307
9									2·79	1241
10									2·69	1152
11			1·35						2·61	1084
12			1·31				4·12		2·57	1050
13							4·96	4166	2·57	1050
14							5·03	4278	2·59	1067
15					1·02		5·31	4726	2·61	1084
16							5·38	4838	2·61	1084
17							5·37	4822	2·66	1120
18	1·31		1·03				5·03	4278	2·63	1101
19							4·81	3926	2·64	1109
20							4·56	3526	2·60	1075
21							4·45	3350	2·55	1033
22							4·50	3430	2·51	999
23							4·37	3222	2·49	982
24							4·17	2905	2·40	910
25							3·82	2598	2·37	888
26			1·22				3·38	1852	2·37	888
27							3·04	1485	2·35	873
28	1·37						2·87	1317	2·35	873
29							2·73	1187	2·28	821
30					1·70		2·63	1101	2·28	821
31									2·24	793

SESSIONAL PAPER No. 25e

No. 67.

River, near Swan River, Man., for 1913.

1,215 square miles.]

Day.	June.		July.		August.		September.		October.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	2·20	765	2·39	903	2·04	653	1·51	350	0·98	141
2	2·13	716	2·73	1187	1·97	606	1·46	327	0·96	134
3	2·07	674	3·24	1694	1·87	542	1·51	350	0·97	137
4	1·99	619	4·67	3702	1·68	435	1·53	360	0·95	131
5	1·96	599	4·58	3558	1·57	380	1·53	360	0·95	131
6	1·93	580	4·52	3462	1·50	345	1·53	360	0·93	125
7	1·83	580	4·24	3014	1·44	318	1·46	327	0·99	144
8	1·92	573	3·95	2580	1·39	296	1·42	309	0·99	144
9	1·87	542	3·68	2214	1·41	305	1·51	350	1·01	151
10	1·81	506	3·46	1944	1·40	300	1·48	336	1·07	172
11	1·75	473	3·57	2074	1·50	345	1·45	322	1·07	172
12	1·75	473	3·76	2318	1·62	405	1·35	280	1·09	179
13	1·67	430	3·97	2608	1·65	420	1·30	260	1·10	182
14	1·66	425	4·09	2664	1·70	445	1·26	244	1·12	190
15	1·65	420	4·62	2680	1·86	536	1·20	229	1·10	182
16	1·59	390	3·97	2608	2·06	667	1·18	212	1·08	175
17	1·54	365	3·87	2468	2·19	758	1·15	201	1·09	179
18	1·48	336	3·69	2227	2·22	779	1·11	186	1·05	165
19	1·43	314	3·41	1887	2·24	793	1·10	182	1·02	154
20	1·39	296	3·13	1577	2·25	800	1·07	172	0·88	109
21	1·39	296	2·91	1355	2·30	835	1·05	165	0·90	115
22	1·33	272	2·71	1169	2·34	865	1·04	161	1·13	193
23	1·25	240	2·47	966	2·23	786	1·01	151	1·08	175
24	1·22	228	2·31	841	2·09	688	1·04	161	1·07	171
25	1·29	256	2·18	751	2·00	625	1·08	175	1·01	151
26	1·26	244	2·12	709	1·89	554	1·07	172	1·01	151
27	1·97	606	2·01	632	1·74	467	1·05	165	0·95	131
28	2·06	667	1·97	606	1·64	415	1·04	161	1·23	232
29	2·03	646	1·97	606	1·62	405	1·03	158	1·04	161
30	2·11	702	2·14	723	1·53	360	1·03	158	1·08	175
31	.....	.....	2·10	695	1·46	327	.....	.....	1·20	220

Red Deer River.

A.—LOCATION.

The Red Deer river (see plate No. 22) rises in township 44, range 19, west of the second meridian, some 15 miles south of Melford, Sask. It flows in an easterly direction to Red Deer lake, and from thence into lake Winnipegosis.

B.—RIVER BASIN.

Similarly to the Swan river, the Red Deer river flows in a deep wide valley of glacial origin, though of greater extent than the valley of the former river. In the upper portion of the watershed, the drainage is collected by several tributary streams, including the Fir, Etoimami, Pipestone and Barrier rivers, which extend over a large tract of country, and head in many small lakes and swamps. A forest growth, composed of spruce and poplar, covers a great extent of this upper district. In the lower reaches of the river, the drainage to the north is somewhat confined, due to a parallel river system. Some ten miles above the mouth, the river passes through Red Deer lake, which has an area of 100 square miles.

C.—NATURE OF BED AND BANKS.

While rock outcrops occur at a few places in the lower reaches of the river, the bed and banks are for the most part composed of sand, gravel and clay, this latter feature being applicable to a greater portion of the Red Deer valley. The bed of the river is also strewn with boulders at many places. The width of the river is stated to vary from 150 to 250 feet, while the banks are stated to range in height from 15 to 50 feet.

D.—TIMBER AND VEGETATION.

As stated previously, there is extensive growth of timber in the upper portion of the drainage. The Red Deer Lumber Company carry on logging operations in this district and operate a saw-mill on Red Deer lake, the logs being floated downstream to the mill.

E.—HIGH AND LOW WATER.

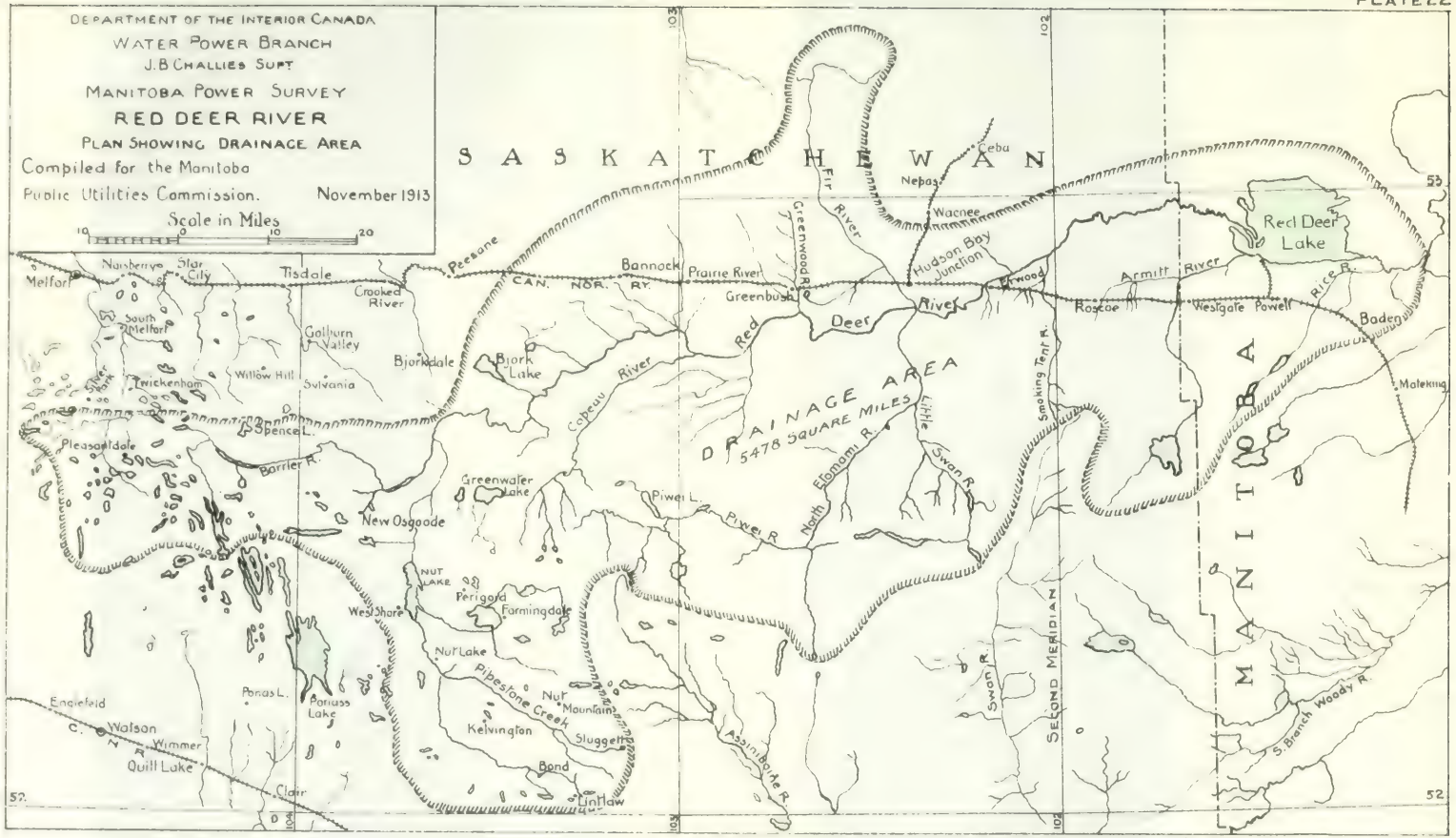
High water under ordinary conditions occurs in the latter part of April or early May, while low water is stated to occur in the winter months, with a range of some 4 to 5 feet between the two periods. Due to ice jams on the river, an extreme range of 14 feet was noted at one point in the spring of 1913.

F.—TRANSPORTATION.

The river is spanned by the Canadian Northern railway at Erwood, some 30 miles west of Red Deer lake. The railway above this point is situated within the vicinity of the river for a considerable distance. A spur line of the same railway also taps Red Deer lake at Barrows.

G.—SURVEYS OF THE RIVER.

A geological survey of the river and adjacent territory has been made by the Geological Survey of Canada. On July 5, 1913, a metering station was established by the Manitoba Hydrographic Survey of the river in the vicinity of Hudson Bay Junction.



Douglas L. McLean Chief Engineer

Stuart D. Scott Asst. Chief Engineer

Red Deer River – Looking at High Bank on Right at Ferry

Red Deer River – Forks of Red Deer and Naumonis Rivers

H.—RUN-OFF.

(*a*) *Precipitation.*—Only meagre records of precipitation are available, and from these it would appear that some 15 inches would represent the mean annual rainfall.

(*b*) *Discharge Measurements.*—As shown in table No. 68, measurements of the discharge have been made near Hudson Bay Junction since July 5, 1913. An estimate of the daily discharge since that date is given in table No. 69.

While these records do not as yet extend over sufficient period to cover a complete water year, it is estimated that the minimum flow is 150 second-feet, this latter figure being subject to revision or verification as future records will indicate.

I.—STORAGE POSSIBILITIES.

No field investigation has as yet been made of the storage possibilities of this river. As many small lakes are situated in the upper drainage, storage should be available, and of sufficient extent to greatly increase the low flow of the river. Red Deer lake, with an area of 100 square miles, offers facilities for a regulation to a considerable extent of the flow from Red Deer lake to lake Winnipegosis. As an indication of the flow available from a one or two-foot storage on a lake of this size, the following table has been prepared. The rates of draft in second-feet are computed for a storage being used in a 6 months or a year period:—

Red Deer Lake.

Depth of Storage.	Capacity in Billion Cu. ft.	Rate of Draft 6 months.	Rate of Draft 1 year.
1	2,787·84	178	89
2	5,575·68	356	178

J.—WATER-POWER.

The head-waters of the Pipestone creek, one of the Red Deer tributaries, rise in a country whose elevation is some 2,000 feet above sea-level, while lake Winnipegosis has an elevation of some 828 feet; so that, approximately, there is some 1,000 feet fall between the head-waters and the mouth of the river. Considerable fall does occur in Manitoba, the fall between Red Deer lake and lake Winnipegosis is stated by the Geological Survey to be some 45 feet. While field investigations of the power possibilities of the river are as yet to be made, the following tentative table gives the power available per foot head based on an 80 per cent efficiency and computed for an estimated minimum flow of 150 second-feet. As stated above, this latter figure is subject to revision:—

Head.	Estimated Horse-power on 80 per cent Efficiency.
1 foot	13·7
10 "	137
20 "	274

TABLE No. 68.

DISCHARGE MEASUREMENTS of Red Deer River, near Hudson Bay Jct., 1913.

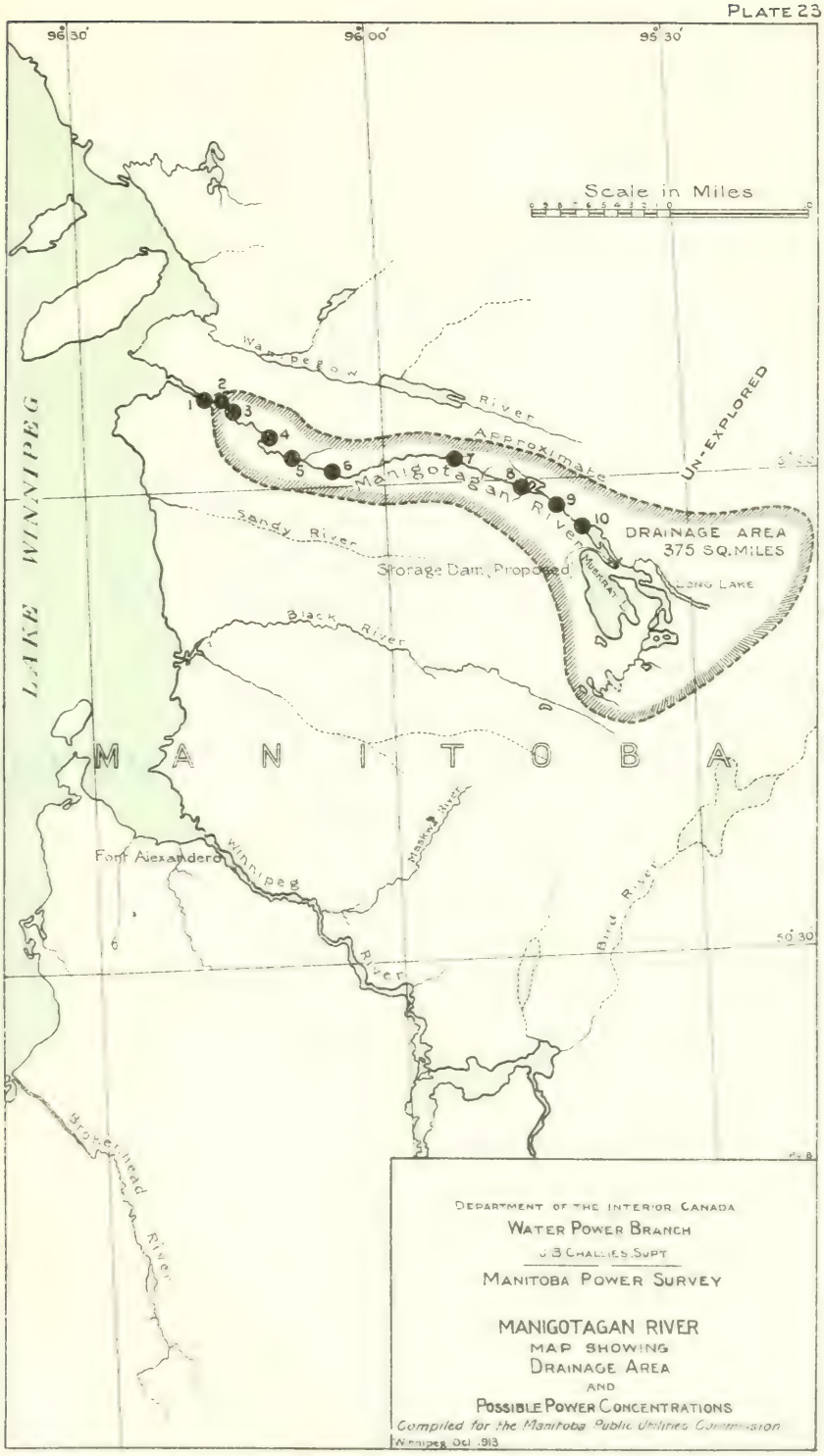
Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
July 5	G. Ebner	1196	183	927	2·53	3·58	2342
" 10	A. Pirie	1496	193	886	2·30	3·31	2034
Aug. 12	G. Ebner	1196	165	765	2·28	3·09	1747
" 30	W. J. Ireland	1469	162	693	2·05	2·79	1419
Sept. 18	W. J. Ireland	1469	162	566	1·36	2·10	768
Oct. 6	C. O. Allen	1435	155	528	1·03	1·78	546

TABLE No. 69.

DAILY GAUGE HEIGHT AND DISCHARGE, Red Deer River, near Hudson Bay Junction, for 1913.

Days.	JULY.		AUGUST.		SEPTEMBER.		OCTOBER.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	.....	3·75	2521	2·77	1394	1·90	625
2	.....	.....	·63	2383	·82	1451	·86	601
3	.....	.....	·48	2210	·79	1417	·82	576
4	.....	.....	·46	2187	·77	1394	·70	507
5	.....	.....	·32	2026	·74	1359	·77	547
6	.....	.....	3·19	1877	2·68	1291	1·80	564
7	.....	.....	·13	1808	·64	1248	·80	564
8	.....	.....	·09	1762	·56	1164	·80	564
9	3·44	2164	·09	1762	·55	1154	·80	564
10	·28	1980	·10	1773	·42	1025	·81	570
11	3·38	2095	3·13	1808	2·46	1064	1·83	582
12	4·00	2808	·09	1762	·42	1025	·86	601
13	·73	3648	·23	1923	·39	997	·82	576
14	5·15	4131	·20	1888	·38	989	·76	541
15	·45	4476	·10	2118	·23	862	·73	524
16	5·60	4648	3·72	2486	2·20	838	1·71	513
17	·68	4740	·66	2417	·16	808	·73	524
18	·50	4533	·67	2429	·11	707	·70	507
19	·58	4395	·69	2452	·08	748	·68	496
20	·17	4154	·66	2417	·08	748	·68	496
21	4·95	3901	3·62	2371	2·05	727	1·65	481
22	·80	3728	·59	2337	·05	727	·68	496
23	·63	3533	·37	2084	·04	719	·68	496
24	·49	3372	·37	2084	·03	712	·71	513
25	·30	3153	·16	1842	·02	705	·60	454
26	4·44	3314	3·05	1716	2·02	705	1·70	507
27	·45	3326	2·92	1566	·01	698	·80	564
28	·40	3268	·89	1532	·00	691	·60	454
29	·25	3096	·82	1451	1·97	671	·40	365
30	·09	2912	·76	1382	·94	651	·73	524
31	3·86	2647	·77	1394	.....	.....	·73	524

PLATE 23



DEPARTMENT OF THE INTERIOR CANADA
WATER POWER BRANCH
J. B. CHALLIES, SUPT.

MANITOBA POWER SURVEY

MANIGOTAGAN RIVER
MAP SHOWING
DRAINAGE AREA
AND
POSSIBLE POWER CONCENTRATIONS
Compiled for the Manitoba Public Utilities Commission
Winnipeg Oct. 1913

Douglas L. McKay, Chief Engineer
Stuart S. Scott, Asst. Chief Engineer

WATER-POWERS OF MANITOBA

CHAPTER VI

RIVERS IN EASTERN PORTION OF MANITOBA

CHAPTER VI.

RIVERS IN THE EASTERN PORTION OF MANITOBA.

Manigotagan River.

General Description of River and Watershed.

A.—LOCATION.

The Manigotagan or Bad Throat river discharges into lake Winnipeg at an inlet on the east shore, about 50 miles north of Fort Alexander and almost directly opposite the centre of Big island. (*See* plate No. 23.)

B.—GENERAL DIRECTION.

The general bearing of the river is west 30 degrees north from Musk Rat lake to its mouth. The flow into Musk Rat lake is said to come from the northeast.

C.—RIVER BASIN.

While the upper reaches of the watershed have not yet been explored, yet it is stated that considerable drainage comes in beyond Long lake. From Long lake to Turtle lake the basin widens out and includes the Caribou, Musk Rat, Moose, Bull Frog and many other small lakes. From Turtle lake to the river mouth there are a number of small creeks draining the adjoining swamps and muskeg. All of these are small and sluggish at their entrance to the river.

D.—NATURE OF BANKS.

At the mouth of the river the banks are of good agricultural clay, partially cleared and occupied by settlers. Even here, however, rock outcrops are found at several places. Above Wood falls the banks are very irregular and in most cases rocky, ranging from 2 feet to 60 or 70 feet in height, being broken by many valleys which lead back to muskegs or swamps. In the upper reaches, ranges of hills skirt the river on either side.

E.—WIDTH OF RIVER AND NATURE OF BOTTOM.

For the first 25 miles the river has an average width of about 175 feet, narrowing down at the many rapids and falls; three or four miles below Turtle lake the channel widens, and from that point to Musk Rat lake there are many places in which it has a width of from 700 to 900 feet. Below each rapid a large circular pool from 500 to 800 feet in diameter is a feature that is noticeable. The banks are overgrown with grass and reeds which extend into the river 50 feet in many places, while willows and alders are found at many points where the banks are low. The river bed is covered with black muck except at falls and rapids, where boulders and rock form the bed.

F.—TIMBER AND VEGETATION.

Almost the entire drainage area is covered with an inferior class of timber which includes a plentiful supply of poplar and spruce, together with jack pine, birch, oak and balsam. In the vicinity of Musk Rat lake, and beyond Moose lake, there is a fringe of valuable spruce bordering the lakes, but this does not appear to extend far

back into the interior. In the immediate vicinity of the river valuable timber has been removed, but fire does not seem to have had any hand in depleting the supply, as is often found where first cutting has been made.

G.—HIGH AND LOW WATER.

High water usually occurs in June, when a height of 3½ or 4 feet above the low-water mark has been noticed. Low water occurs in the fall, and in March or April.

H.—TRANSPORTATION.

Small steamers can navigate to the foot of Wood falls, but beyond this point canoes are the only means of transportation on account of the numerous rapids and falls. A winter road has been cut through from Manigotagan settlement to Musk Rat lake. This road crosses and recrosses the river, and so is only of use during the severe winter months.

I.—SETTLEMENTS.

The only permanent settlement at present is at the Manigotagan post office at the mouth of the river. The Phœnix Brick, Tile and Lumber Company have been making brick at this point with a modern plant, and have also operated a sawmill in conjunction with their brick plant.

J.—SURVEYS OF THE RIVER.

The Geological Survey of Canada made a geological reconnaissance of this river in 1890 and 1891 from its mouth to Long lake; since that time a few isolated land surveys for timber berths and settlement areas have been made. In December, 1912, a meter station was established by the Manitoba Hydrographic Survey and a reconnaissance made of Wood and Poplar falls. In the following year during the month of June a reconnaissance of the river from Wood falls to Long lake was made by the Manitoba Hydrographic Survey, with D. B. Gow in charge of party.

K.—RUN-OFF.

(*a*) *Rainfall.*—There are no rainfall records available for this drainage area, but it is estimated that a mean annual rainfall of some 21 inches might be expected.

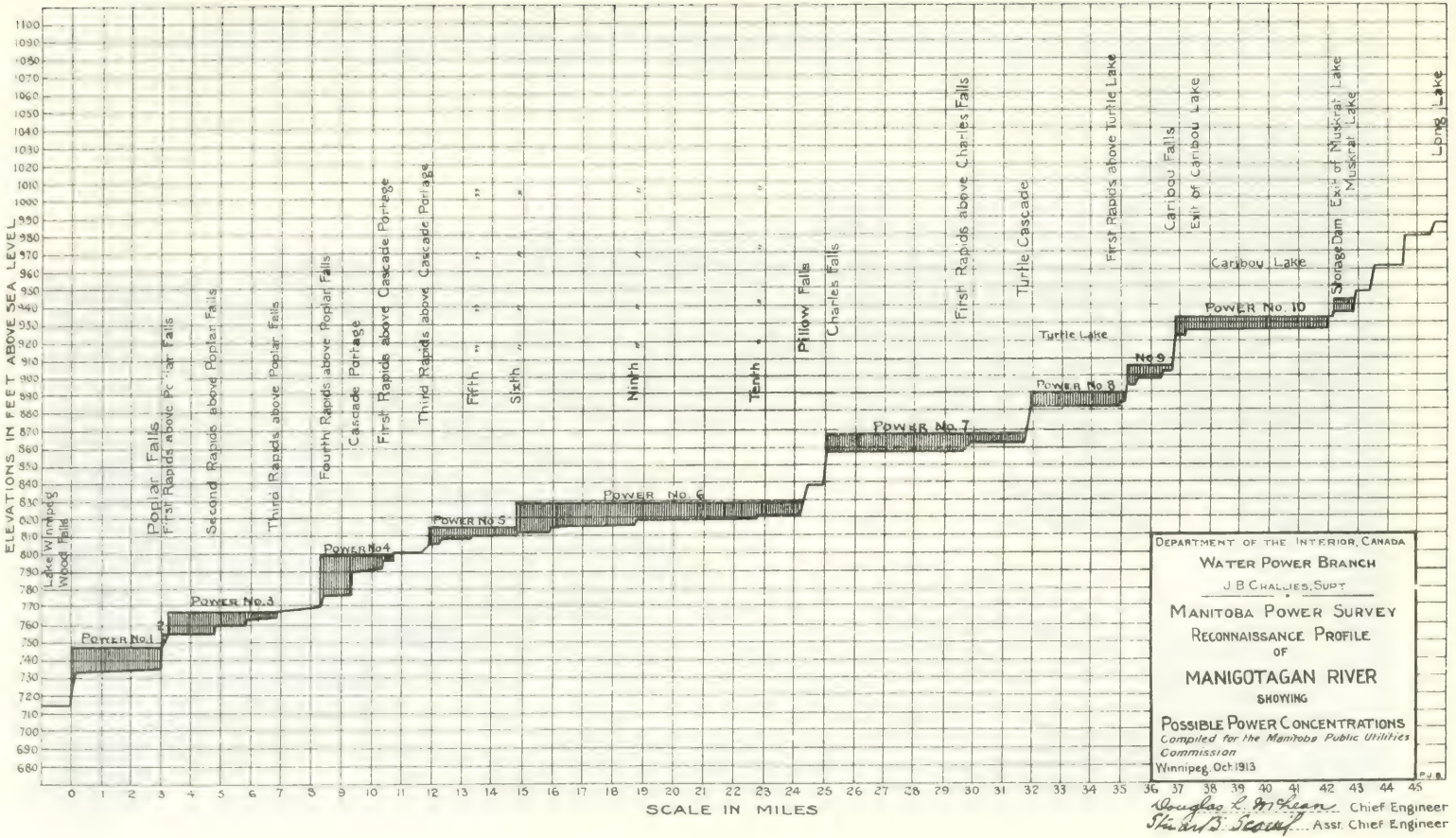
(*b*) *Discharge Measurements.*—Meterings have been taken at the mouth of the river by the Manitoba Hydrographic Survey and results of this work estimated to the end of the year 1913, may be found in tables No. 70 and No. 71. From these records it will be seen that the minimum discharge would be about 30 second-feet, and the flood discharge some 1,200 second-feet.

(*c*) *Mass Curve, 1913.*—By using the run-off data at present on hand for 1913 and estimating the probable flow for the remaining months of the year, it is found that a uniform flow of 150 second-feet could have been maintained had there been a storage reservoir capable of holding 1·45 billion cubic feet of water. (*See* plate No. 25.)

L.—STORAGE POSSIBILITIES.

From mass curve studies for year 1913 it will be seen that a storage of 1,450,000,000 cubic feet would be required to produce uniform run-off; this could be obtained by using Musk Rat lake. This lake has an area of 8·3 square miles, and it would be possible to store some 7·8 feet. This would give a storage capacity of 1·8 billion cubic feet, so that ample storage could be provided for on this lake.

PLATE 24



DEPARTMENT OF THE INTERIOR, CANADA

WATER POWER BRANCH

J. B. CHALLIES, SUPT.

MANITOBA POWER SURVEY

RECONNAISSANCE PROFILE

OF

MANIGOTAGAN RIVER

SHOWING

POSSIBLE POWER CONCENTRATIONS

Compiled for the Manitoba Public Utilities Commission

Winnipeg, Oct. 1913

P.W.B.

Douglas L. McLean ..... Chief Engineer

Stuart B. Scarth ..... Assr. Chief Engineer

Manigotagan River- Wood Falls, N side of Dam Site

PLATE 25

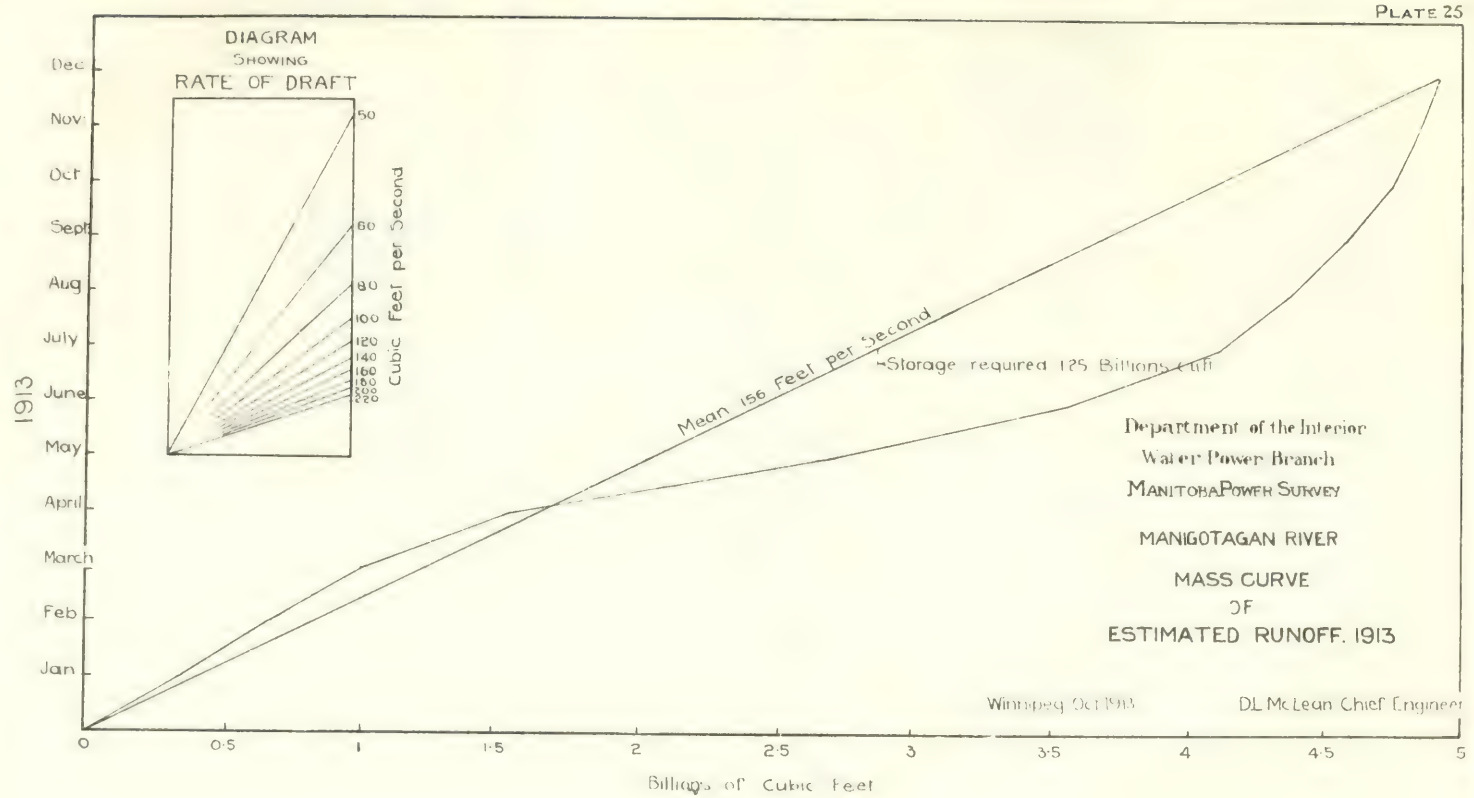


DIAGRAM
SHOWING
RATE OF DRAFT
Dec
Nov
Oct
Sept
Aug
July
June
May
April
March
Feb
Jan
1913
50
60
80
100
120
140
160
180
200
Cubic Feet per Second
Mean 156 Feet per Second
Storage required 125 Billions Cu ft
Department of the Interior
Water Power Branch
MANITOBA POWER SURVEY
MANIGOTAGAN RIVER
MASS CURVE
OF
ESTIMATED RUNOFF. 1913
Winnipeg Oct 1913
D.L. McLean Chief Engineer
0
0·5
1
1·5
2
2·5
3
3·5
4
4·5
5
Billions of Cubic Feet

There are a number of water-powers on the river that might be developed, and these are shown on the profile, plate No. 24. The following tabulation shows possible power concentrations under conditions of minimum flow and under regulated flow based on records of 1913, and gives the power at 80 per cent efficiency:—

No.	Name.	Head.	Horse Power Estimated on 80 per cent Efficiency.	
			Min. Flow.	Reg. Flow.
1	Wood falls	33	90	449
2	Poplar falls	8	22	109
3	First rapid above Poplar falls	12	33	163
4	4th rapid above Poplar falls	30	82	408
5	3rd rapid above Cascade Portage	12	33	163
6	6th rapid above	18	49	245
7	Charles falls	34	92	462
8	Turtle cascade	28	76	381
9	2nd rapid above	21	57	286
10	Caribou falls	27	74	368
	Total Horse-power		608	3034

TABLE No. 70.

Miscellaneous Measurements in Manigotagan River drainage basin in 1912-13, by Manitoba Hydrographic Survey.

Date.	Stream.	Locality.	Gauge Height.	Discharge.
1912.			Feet.	Sec.-feet.
Dec. 28.	Manigotagan	Wood falls	4·00	144
1913.				
May 26.	"		*5·1	469
May 31.	"	1½ Miles below Cascade Portage*	*5·0	423
June 4.	"	2 Miles below Turtle Lake		323
June 7.	"	Outlet of Muskrat Lake		288
June 10.	"	Head of Muskrat Lake		168
June 14.	"	Outlet of Moose Lake		47
June 18.	"	Caribou Rapids		293
Aug. 23.	"	Wood falls	*3·74	93

* Referred to Gauge above Wood Falls.

4 GEORGE V., A. 1914

TABLE

DAILY GAUGE HEIGHT AND DISCHARGE,

[Drainage area,

Day.	JANUARY.		FEBRUARY.		MARCH.		APRIL.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			3·95		3·90			
2								
3								
4	4·00							
5							4·00	
6								
7								
8			3·95		4·00			
9								
10								
11	4·00							
12							3·80	
13								
14								
15			3·95		4·00			
16								
17								
18	3·95							
19							4·60	290
20							·55	276
21							4·53	276
22			3·90		4·00		·50	262
23							·50	262
24							·50	262
25	3·95						·50	262
26							4·50	262
27							·58	284
28							·60	290
29					4·00		·60	290
30							·60	290
31								

SESSIONAL PAPER No 25e

No. 71.

Manigotagan River, above Wood Falls, for 1913.

313 square miles.]

Days.	May.		June.		July.		August.		September.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	4·70	320	5·00	424	4·80	352	3·84	112	3·69	·87
2	·70	320	4·99	420	·40	235	·84	112	·89	1·21
3	·77	342	5·00	424	·50	262	·84	112	·66	·83
4	·80	352	·00	424	·50	262	·74	95	·46	·55
5	·84	366	·10	464	·40	235	3·94	131	·66	·83
6	4·90	386	4·90	386	4·40	235	3·84	112	...	...
7	·92	394	·90	386	·30	210	·84	112	...	...
8	·90	386	·90	386	·80	352	·74	95	....	...
9	·96	409	·80	352	·30	210	·74	95	...	...
10	5·00	424	·80	352	·20	186	·34	42	...	...
11	5·00	424	4·80	352	4·30	210	3·64	·80	...	...
12	·08	456	·75	336	·30	210	·74	95	...	...
13	·10	464	·73	330	·30	210	·74	95	...	...
14	·10	464	·70	320	·40	235	·84	112	...	...
15	·10	464	·70	320	·20	186	·84	112	...	...
16	5·00	424	4·69	317	4·20	186	...	110	...	...
17	·10	464	·69	317	·20	186	...	110	...	...
18	·10	464	·70	320	·50	262	...	105	...	...
19	·12	473	·80	352	·10	164	...	105	...	...
20	·12	473	·60	290	·10	164	...	105	...	...
21	5·10	464	4·60	290	4·20	186	...	100	...	...
22	·10	464	·60	290	·20	186	...	100	...	...
23	·10	464	·50	262	·10	164	3·74	95	...	...
24	·10	464	·70	320	·00	143	·74	95	...	...
25	·10	464	·60	290	·10	164	·76	99	...	...
26	5·10	464	4·60	290	4·10	164	3·64	80	...	...
27	·10	464	·50	262	·10	164	·66	83	...	...
28	·08	456	·60	290	·10	164	·66	83	...	...
29	·00	424	·50	262	·10	164	·66	83	...	...
30	·10	464	·50	262	·20	186	·67	84	...	...
31	·09	424	...	...	·10	164	·66	83	...	...

Bloodvein River.

A.—LOCATION.

The Bloodvein or Miskowow river (*see* plate No. 26) discharges into a bay on the east shore of lake Winnipeg situated at the northerly portion of the narrows separating the two main bodies of the lake.

B.—DIRECTION OF FLOW.

In the upper reaches the river flows in a westerly direction, but in the vicinity of lake Winnipeg the river bends slightly to the north.

C.—GENERAL DESCRIPTION OF RIVER AND BASIN.

While little is known of the head-waters of the river, it is estimated that the drainage basin comprises an area of 3,000 square miles. The greater portion of the basin is rocky and of granitic formation, with the occurrence, at some few places, of a light covering of clay. Several small tributary streams enter the Bloodvein from the north, and in the upper watershed the river is divided into two branches, the northerly branch heading in Sassaginnigak lake, while the southerly branch is stated to reach out to the height of land separating this drainage basin from that of the English river

In the vicinity of the mouth, the banks of the river, which has an average width of 150 feet, are composed of clay, and about 5 feet in height. Some 9 miles up stream the first rapids on the river occur. A short distance above this point the Little Bloodvein river is tributary in a stretch where the river makes several sharp bends. From this point to the junction of the Turtle river, a distance of from 35 to 40 miles, there are many rapids and falls, some of which are stated to have deep descents; the banks, for the most part, are rocky and low, giving way occasionally to marsh and muskeg, yet at some places they rise from 10 to 20 feet in height, being at these points composed of clay or clay and gravel overlying the rock outcrop. The country in the vicinity of the river is stated to be very rocky, with a very slight covering of soil. It is also stated that the district presents the same general characteristics until in the vicinity of Kowtunigan lake, at which point the north and south branches of the river occur. The south branch heads in a region of which little is known, while the north branch again operates into two branches both of which head in the same lake. This lake, which is known as the Sasaginnigak lake, and is stated to have an extreme length of about four miles and a width of about two, is dotted with numerous islands. Of the territory tributary to the lake little is known.

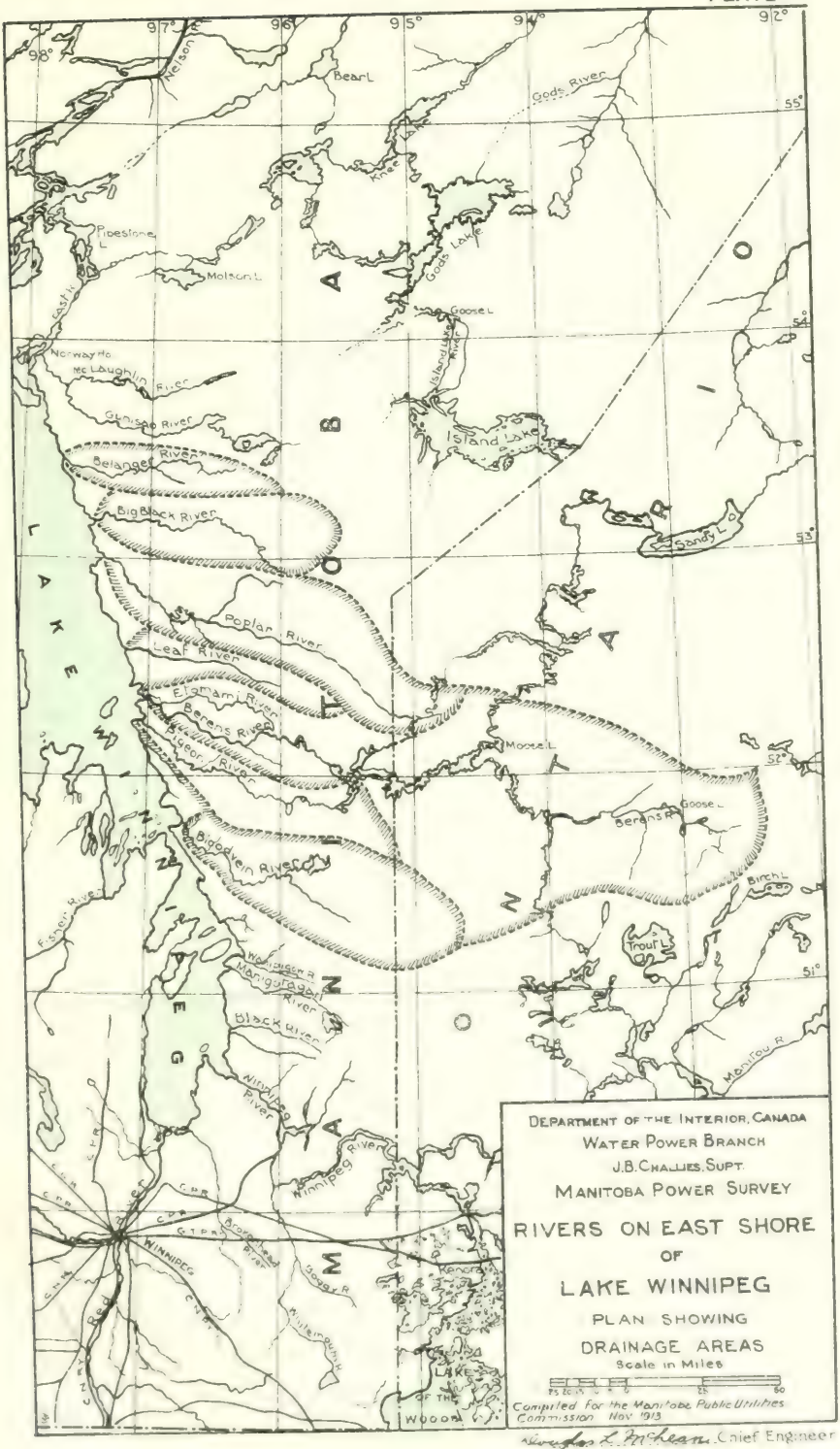
D.—NAVIGATION AND ACCESSIBILITY.

Navigation of this river is impossible other than by canoe, and even by this means many portages are necessary. The mouth of the river is easily reached during the summer months, as it is within a short distance of the route followed by steamers on lake Winnipeg.

E.—WATER-POWER.

Similar to most rivers discharging into lake Winnipeg from the east, the adjoining country is rocky and many rapids occur throughout the extent of the river. While no survey as yet has been made as to the power possibilities of this river, the information available would indicate that there are such possibilities. Based on an assumed mean annual run-off of 0·3 second-feet per square mile and a drainage area of 3,000 square miles, the mean annual discharge would be 900 second-feet.

PLATE 26



DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
J.B. CHALLIES, SUPT.
MANITOBA POWER SURVEY

RIVERS ON EAST SHORE OF LAKE WINNIPEG

PLAN SHOWING
DRAINAGE AREAS
Scale in Miles

Compiled for the Manitoba Public Utilities Commission Nov. 1913

Vaughan L. McLean, Chief Engineer
Stuart S. Savary, Asst. Chief Engineer

Pigeon River.

A.—LOCATION.

The Pigeon river (*see* plate No. 26) discharges into lake Winnipeg at a point on the easterly shore, some six miles below the mouth of the Berens river.

B.—GENERAL DIRECTION.

For the first 20 miles below the head-waters, the course of the river is due west, but below this the flow is in a northwesterly direction to lake Winnipeg.

C.—RIVER AND BASIN.

The river basin, which comprises an area of 925 square miles, has its head-waters in Family lake, through which the Berens river is also stated to flow. In its course, the river at various points widens out into several small lakes including Round lake, Goose lake and Little Goose lake. The banks of the river, for the most part, are composed of clay overlying beds of granite, which outcrop both at the rapids and falls, and many points along the river.

In the stretch of river from the mouth to Sturgeon falls, in extent some 14 miles, there is the occurrence of some two rapids. Above Sturgeon falls the banks at first give way to marshy indentations, but further upstream clay banks, gradually rising to a height of some 11 feet, again occur. In this stretch of river from Sturgeon to Poplar falls, which in a direct line between the two points is some 10 miles, the stream is very winding and sluggish. Many rapids occur between Poplar falls and Round lake, with the banks for the greater part slightly higher than found below. Above Round lake the country is stated to be hilly and rocky, with a much thinner overlying blanket of clay. Many rapids and falls occur throughout this portion of the river, some of them being stated to have sharp descents of from 14 to 20 feet.

D.—TRANSPORTATION AND ACCESSIBILITY.

Due to the many rapids on the river, necessitating portages, navigation is only possible by canoe. Lake steamer in the summer months and dog team in the winter form the only means of access to the river.

E.—WATER-POWER.

No field investigation has yet been made as to the power possibilities of this river, yet the existence of many rapids and falls would indicate possibilities of power concentration, and also the occurrence of several lakes along the river would suggest storage possibilities. Assuming that the mean annual run-off is 0·3 second-feet per square mile, would give a mean annual discharge of approximately 270 second-feet at the outlet of the river.

Berens River.

A.—LOCATION.

The Berens river (*see* plate No. 26), which is the largest river with the exception of the Winnipeg draining the territory to the east of lake Winnipeg, discharges into an inlet of this lake approximately 140 miles north of the southerly end of the lake.

B.—DIRECTION OF FLOW.

From the head-waters to lake Winnipeg, the general course of the river is in a westerly direction.

C.—RIVER AND BASIN.

The extent of the drainage basin of the Berens river is estimated at 7,800 square miles, and the total length of the river in the neighbourhood of 300 miles. The head-waters of the drainage which are situated in Ontario, are encircled by the height of land in which lies the source of the Severn and Albany, and also tributary English river drainage. In Manitoba, in the vicinity of lake Winnipeg, the basin is confined between those of the Pigeon, Leaf and Poplar rivers. While the head-waters as yet have not been fully explored, it is known that the river widens out into many lakes, together with tributaries heading and passing through several lakes, the main tributaries being the Windfall, White, Crooked Mouth, and Etiomami rivers. The general nature of the country is rocky, with a varying depth of overlying clay soil. In the reaches of the river from the mouth to the junction of the Etiomami river, a distance of six miles, the banks which vary in height from 10 to 20 feet, are alternately composed of rock and clay, occasionally giving way to low-lying swamp land. Some 5 miles above the entrance of this tributary, the first rapids which is stated to be of some 9 feet drop, is encountered. From this rapids to Family lake, which is situated some 18 miles west of the Manitoba boundary, there are stated to be fifty-two rapids and falls of varying height, but all of which require portages. The main descent, which is known as Grand rapids is at the outlet of Family lake and is stated to be approximately a 40-foot drop. Family lake is triangular in shape, very irregular in outline, and about 10 miles in length. In this lake the Pigeon river is also stated to obtain its source. A short distance above Family lake, another rapid with a drop of some 35 feet occurs, while slightly beyond this, the river again widens out into Black or Fishing lake, which is some 9 miles in length and 2 to 4 miles in width. In this portion of the basin the country becomes more rugged, and instead of the very low hills in the vicinity of the mouth, the latter range in height from 125 to 150 feet above the lake level. Between Eagle lake, which is situated on the provincial boundary, and Fishing lake, there are many small rapids. The difference in elevation between the two lakes is stated to be some 50 feet. Above Eagle lake, in Ontario, the river widens out into several lakes with many rapids intervening.

D.—SETTLEMENTS.

Outside of the Indian reserve, which is situated at the mouth of the river and two Hudson Bay posts, one at the mouth and one at Grand Rapids, no settlements occur in the vicinity of the river.

E.—NAVIGATION AND ACCESSIBILITY.

The river is not navigable other than by canoe, and in this latter manner many portages are necessary. Though no railroads are as yet located in this district, the river is accessible at its mouth by lake steamer during the period of navigation on lake Winnipeg.

F.—RUN-OFF.

(*a*) *Precipitation.*—Records of the annual precipitation are available for a period of 5 years at a station situated at the mouth of the river, and though not of sufficient duration to show the extreme variations, they indicate an annual mean of some 21 inches.

(*b*) *Discharge Measurements.*—While a discharge measurement of 1,215 second-feet was obtained on this river on October 1, 1913, by Alexander Pirie, of the Manitoba Hydrographic Survey, the flood and minimum discharges are not as yet, obtained.

G.—WATER-POWER.

Considering the extent of the drainage basin, together with the numerous lakes occurring therein, and the many rapids and falls throughout the course of the river, both in Manitoba and Ontario, the power possibilities of the river are extensive. The fall which occurs between Goose lake, lying in the head-waters, and the mouth, is stated to be some 1,200 feet, a drop of approximately 500 feet, and of this a great portion occurs in the province of Manitoba.

Poplar River.

A.—LOCATION.

The Poplar river (*see* plate No. 26) flows into an inlet on the east shore of lake Winnipeg about midway between the north and south extremities of the upper main body of the lake.

B.—GENERAL DIRECTION.

The general bearing of the river from its source to lake Winnipeg is in a northwesterly direction.

C.—RIVER AND BASIN.

The Poplar river has a drainage basin of an approximate area of 1,950 square miles. The lower portion of the drainage is confined between the Big Black and the Leaf river systems, but above this the drainage widens out. Great portions of this upper watershed are stated to be low and swampy, with rocky ridges at various points. Practically all drainage from the head-waters passes through Thunder lake, situated some 25 miles above the mouth of the river.

D.—NAVIGATION AND ACCESSIBILITY.

Similar to practically all streams discharging along the east shore of lake Winnipeg, the Poplar river is only navigable by canoe, and as no railroad as yet extends through this territory, the only means of access is by lake Winnipeg steamers.

E.—SETTLEMENTS.

An Indian reserve is situated at the mouth of the river, but no other settlements are in the immediate vicinity.

F.—POWER POSSIBILITIES.

The power possibilities of this river have not as yet been investigated, but it is stated that several rapids occur, the more important being in the reach of the river below Thunder lake. An estimate of the mean annual discharge of the river, based on a run-off of 0·3 second-feet per square mile, per year would give a discharge of some 585 second-feet.

Big Black River.

A.—LOCATION.

The Big Black river (*see* plate No. 26) discharges into an inlet on the east shore of lake Winnipeg, about 40 miles south of the northerly extremity of the lake.

B.—GENERAL DIRECTION.

The general direction of the river from its source is northwesterly, though at mid-point in its course it obtains a more westerly bend.

C.—RIVER AND BASIN.

While little is known of the head-waters of the drainage area, the latter is estimated to be 1,350 square miles. About 40 miles above the mouth, the Pelican river is tributary to the Big Black. In the country tributary to the stretch of river from the mouth to the junction of the Pelican, the overlying soil is clay, with rock outcrops. In the upper reaches the land is stated to be low and swampy, and the banks marshy, with fringes of reeds and rushes extending into the river. In the lower reaches comprising the clay belt, a mixed growth of pine, spruce, balsam and poplar is reported, but the growth in the upper watershed is principally of willows.

D.—NAVIGATION AND ACCESSIBILITY.

The river is only navigable by canoe, and the only means of access is by boat from Selkirk during period of navigation.

E.—SETTLEMENTS.

There are no settlements in the vicinity of the river, but it is stated that trappers frequent the region in winter in quest of fur.

F.—RUN-OFF.

Assuming a drainage of 1,350 square miles and mean annual run-off of 0·3 second-feet per square mile, this would give a mean annual discharge of some 400 cubic feet per second.

G.—POWER POSSIBILITIES.

Being situated in an unsurveyed portion of Manitoba, and also at a point which is difficult of access, little is known as to the extent of the fall occurring on this river, but from what information is available it is known that there are rapids at several points.

BELANGER RIVER.

A.—LOCATION.

The Belanger river (*see* plate No. 26) discharges into lake Winnipeg on its eastern shore about 20 miles from the northerly end of the lake.

B.—GENERAL DIRECTION.

The river, which has its source in the vicinity of Gunisac lake, flows in a westerly direction to lake Winnipeg.

C.—RIVER BASIN.

The Belanger river drains an area estimated to be 730 square miles. The basin is narrow, being from 10 to 15 miles in width and lying between the Gunisac river to the north and the Big Black river to the south. The country for the most part is level, with the exception of a few rocky hills.

D.—NATURE OF BANKS.

For the first nine miles above the mouth the banks are stated to be from 6 to 15 feet in height, and composed of clay with very few rock outcrops. Outcrops do, however, occur at all rapids throughout the extent of the river. The banks above the first rapids gradually increase in height to some 18 feet, being still composed of clay. In the upper reach of the river, rock outcrops and overlying soil of clay are encountered both at rapids and along the quieter stretch of the river.

E.—WIDTH OF RIVER AND NATURE OF BOTTOM.

For the first 9 miles the river is stated to vary in width from 200 to 300 feet: above this the river narrows and in the head-waters the bed is strewn with boulders.

F.—TIMBER AND VEGETATION.

It is stated that a considerable portion of the tributary territory has been burnt over, with the destruction of considerable timber, but there is still a growth of poplar and black spruce in the vicinity of the river. In the upper reaches timber growth still remains in a state of nature.

G.—NAVIGATION AND ACCESSIBILITY.

Due to several rapids on the river, navigation is only possible by either row-boat or canoe. During the open season of lake Winnipeg navigation, the mouth of the river is accessible by steamer from Selkirk, but during winter months dog team is the only means of access.

H.—RUN-OFF.

Though the upper reaches of the watershed have not been as yet explored, it is estimated that the Belanger river has a drainage area of 730 square miles. Assuming that the mean annual run-off is 0·3 cubic feet per second per square mile, this would give a mean annual discharge of 225 cubic feet per second at the outlet.

In the absence of discharge measurements, no estimate is made as to the flood or minimum flow, and even the mean stated above is subject to revision when such data is obtained.

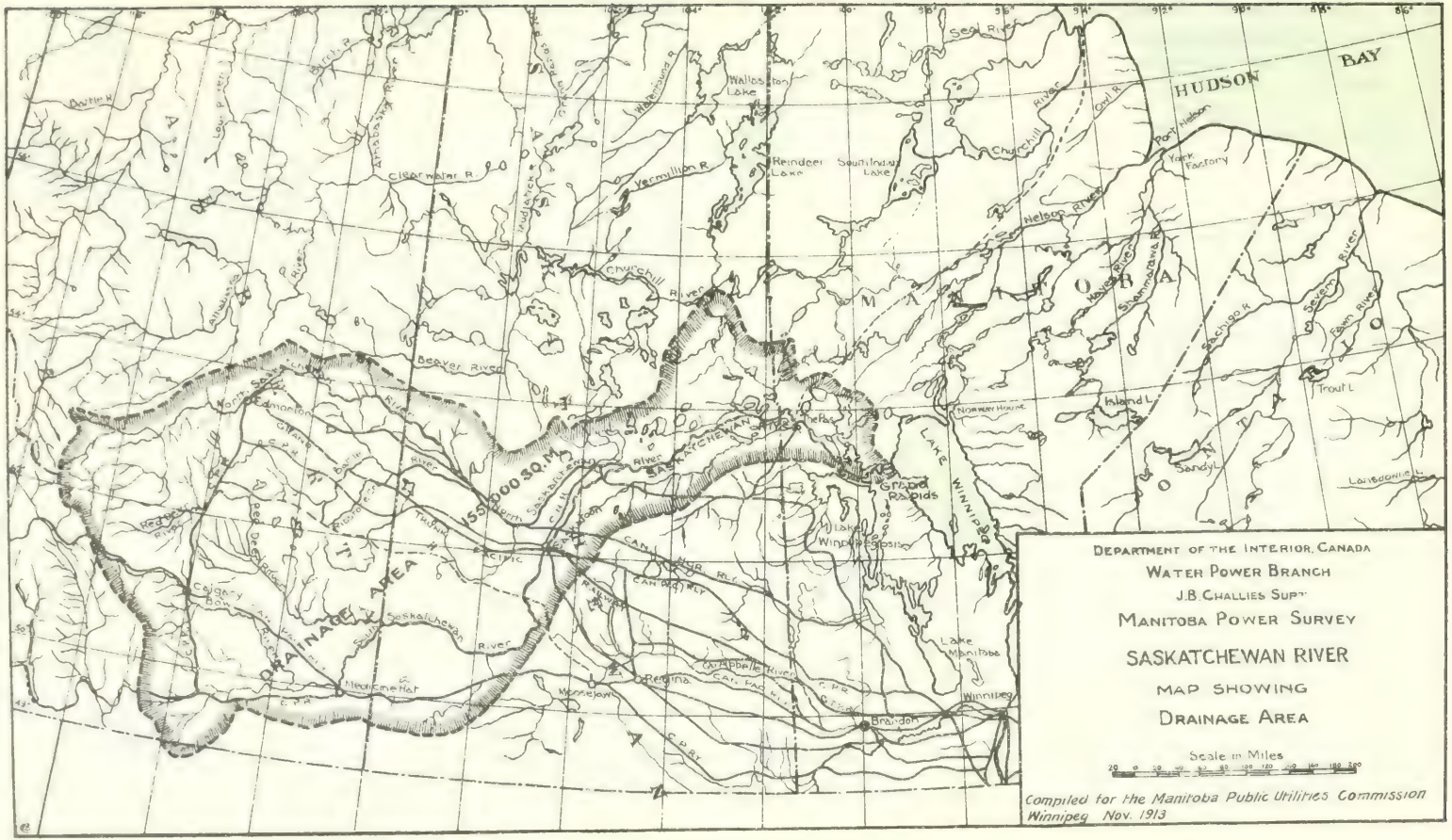
I.—POWER POSSIBILITIES.

Investigations as to the power possibilities of this river have as yet not been made, but it is known that considerable drop occurs throughout the river, and also that this drop is concentrated at several points, which would indicate power possibilities. At the first rapids above the mouth a drop of about 8 feet is reported, while above this there are many rapids which are impossible to navigate and necessitate portages.

WATER-POWERS OF MANITOBA

CHAPTER VII

SASKATCHEWAN RIVER



DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
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MANITOBA POWER SURVEY

SASKATCHEWAN RIVER

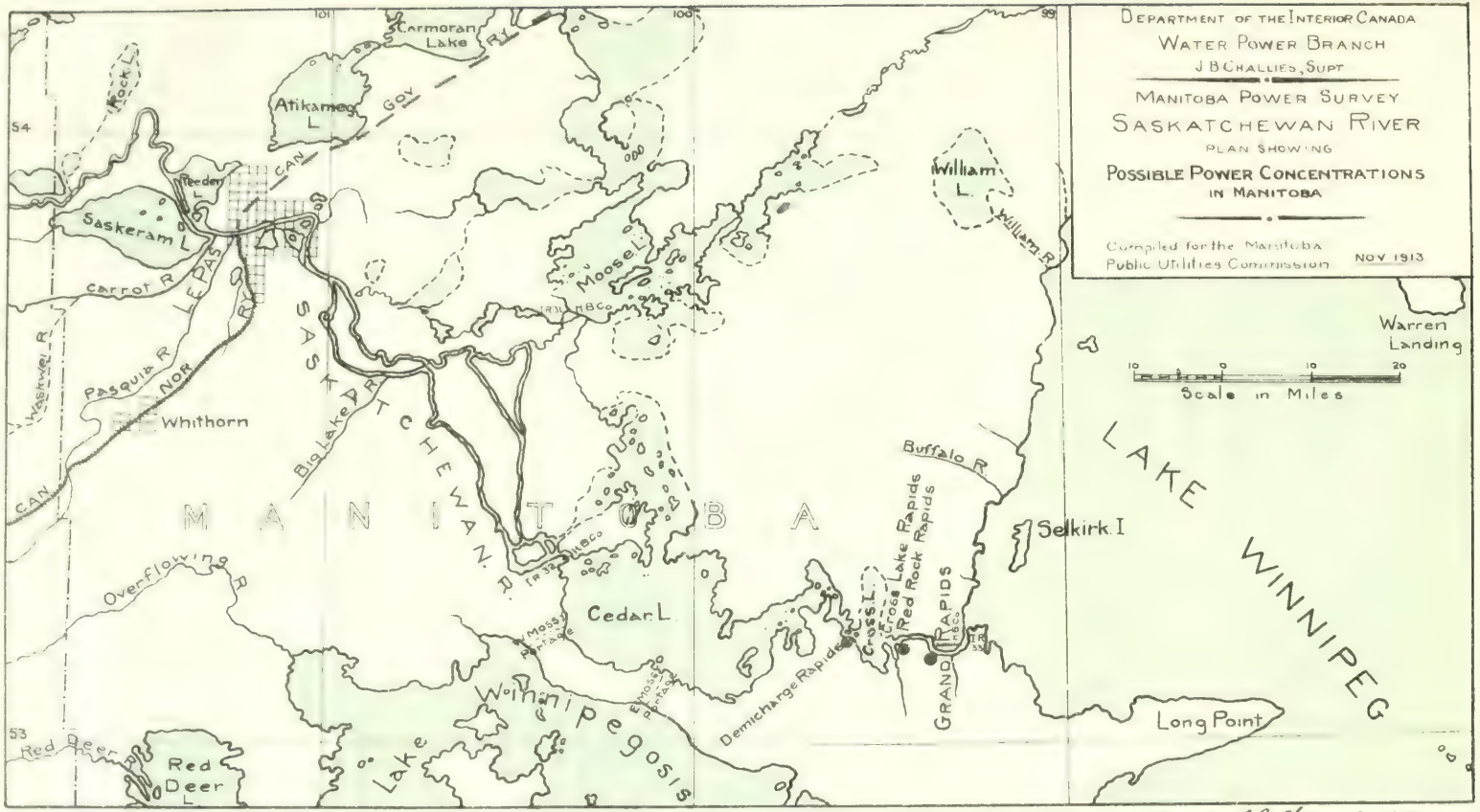
MAP SHOWING
DRAINAGE AREA

Scale in Miles
20 0 20 40 60 80 100 120 140 160 180 200

Compiled for the Manitoba Public Utilities Commission
Winnipeg Nov. 1913

Douglas L. McLean Chief Engineer
Sinclair S. Stead Asst. Chief Engineer

PLATE 28


DEPARTMENT OF THE INTERIOR CANADA
WATER POWER BRANCH
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MANITOBA POWER SURVEY
SASKATCHEWAN RIVER
PLAN SHOWING
POSSIBLE POWER CONCENTRATIONS
IN MANITOBA
Compiled for the Manitoba Public Utilities Commission
NOV 1913
Scale in Miles
Stormoran Lake
Atikameg L.
Saskeram L.
Feeder L.
Carrot R.
Pasquia R.
Whitkwel R.
Whitkorn
Big Lake
Moose L.
William L.
William R.
Warren Landing
Buffalo R.
Selkirk I.
LAKE WINNIPEG
MANITOBA
SASKATCHEWAN R.
Overflow
Cedar L.
Moss Portage
Cross L.
Lake Rapids
Red Rock Rapids
GRAND RAPIDS
Demicharge Rapids
Long Point
Lake Winnipegosis
Red Deer
Red Deer L.
Douglas L. McLean Chief Engineer
Stuart J. Stovel Asst. Chief Engineer

CHAPTER VII.

The Saskatchewan River in Manitoba.

A.—LOCATION.

The Saskatchewan river enters Manitoba from the west, (*see* plate No. 28), crossing the boundary between Saskatchewan and Manitoba almost directly opposite the north end of lake Winnipeg, and enters the lake some 50 miles south of the lake's northerly end.

B.—RIVER BASIN.

The area drained by the Saskatchewan river (*see* plate No. 27) which is in extent, approximately, 155,000 square miles, comprises a great portion of the western plains The head-waters lie in the Rocky mountains, and the drainage, though collected by many tributaries, is carried across the prairies by two large rivers, known as the North and South Saskatchewan. The North branch heads in the Rockies west of Edmonton, while the Southern branch heads in the same mountain range approximately on a line west of Medicine Hat. Intermediate between these two branches is situated the Red Deer river, a stream of almost as great an extent as the Southern branch which it joins. The distance between the two rivers gradually diminishes with a consequent contraction of the drainage until about 30 miles below Prince Albert the junction of the north and south branches occurs. From the junction to lake Winnipeg the flow is mostly confined to a single bed, although in places it is divided into main and secondary channels, as at the Sepannock channel, due to the generally flat and low-lying nature of the country, and to the consequent ease with which the river can and does, at times, change its bed. In Manitoba the river flows through a low-lying region in which occur innumerable lakes and swamps. Great portions of the surrounding land are subject to floods during periods of high water. In the vicinity of lake Winnipeg the river enters Cedar lake and discharges from this lake into Cross lake, the Demi Charge rapids occurring in this portion of the river. From Cross lake to lake Winnipeg a series of rapids occur comprising the Cross Lake rapids, Bed Rock rapids and Grand rapids.

C.—NATURE OF BANKS.

In the vicinity of Le Pas, the banks range from 15 to 25 feet in height, but they become gradually lower as Cedar lake is approached. The shores of this latter lake, as also the banks in the stretch of river to Cross lake, are rocky. From Cross lake to the mouth of the river outcroppings of limestone occur at the water's edge. At Cross Lake rapids this outcrop reaches a height of from 2 to 6 feet. In the vicinity of Red Rock rapids the right bank is composed of limestone of some 6 feet in height, while the left shows no rock outcrops, being composed of clay and of some 12 feet in height. From Red Rock rapids to Grand rapids, the banks which are of clay gradually become higher. At the latter rapids, limestone is again encountered, rising in some places 30 feet above river level. A high ridge of lightly-coloured boulder clay overlying limestone rises to a height of some 60 feet about the mid-point of Grand rapids. This ridge, which forms the barrier between Cedar lake and lake Winnipegosis, crosses the Saskatchewan about three miles above the mouth. Near the foot of Grand rapids a

gully, which was probably at one time an overflow channel, sweeps inland from the left bank and returns to the main river a mile farther down.

D.—WIDTH OF RIVER AND NATURE OF BANKS.

The river in Manitoba has an average width of about 1,000 feet; a minimum width of approximately 500 feet occurs in Grand rapids, widening to 2,400 feet below the rapids. From the Manitoba boundary to Cedar lake the river has a mud-and-gravel bottom, with the occurrence of shifting bars. In the reaches below this section the bed of the river at various rapids is composed of limestone, while many beds of boulders occur in the intervening spaces.

E.—TIMBER AND VEGETATION.

A valuable timber growth occurs a slight distance above Le Pas, but from there to Cedar lake the growth is stunted; and while a dense growth occurs around both Cedar and Cross lakes, yet the timber occurring below this is largely of second growth.

F.—HIGH AND LOW WATER.

High water usually comes during the months of July and August, while low water occurs in the winter months, the river reaching its lowest stage about the month of March. At Le Pas the range between these two periods is ordinarily some 15 feet, while at Grand Rapids the range is gradually lessened, being ordinarily from 4 to 5 feet, with an extreme of some 6 feet. During the spring break-up the field ice of lake Winnipeg occasionally becomes jammed at the mouth of the river, damming the outlet and causing a rise at the lake of from 12 to 15 feet.

G.—NAVIGATION AND ACCESSIBILITY.

The Saskatchewan is navigable above Grand rapids, the Hudson's Bay Co. having at one period run steamers as far upstream as Edmonton. The river at present is navigated by gasolene launches from Le Pas to Cedar lake. It is accessible by railroad at Le Pas, and also by steamer at the mouth.

H.—SETTLEMENTS.

With the exception of Le Pas, no settlements of any size occur in the lower reaches of the river. A Hudson's Bay post is situated at Cedar lake and a small settlement occurs at Grand Rapids.

I.—SURVEYS OF THE RIVER.

In 1884, Dr. Otto Klotz made a traverse of the river. The late R. E. Young made a survey of the settlement in the year 1903 and continued his traverse to the head of Grand rapids, obtaining at the same time a profile of the portage. In 1909 a reconnaissance survey of the river was made from Le Pas to lake Winnipeg by E. A. Forward, of the Public Works Department. The investigations made by the Water-power Branch of the Department of the Interior comprise a reconnaissance power survey by the late William Ogilvie in the year 1911, and in the following year a detailed survey of Grand rapids and vicinity from lake Winnipeg to Cross lake. This latter survey was carried out by E. B. Patterson, in charge of a field party of the Manitoba Power Survey. At the same time a gauging station was established at Grand rapids and discharge measurements were then and have since been obtained at this station.

J.—RUN-OFF.

(*a*) *Precipitation.*—No complete records are available for the precipitation in either the extreme western or eastern portion of the drainage. The following table obtained from the Meteorological records of Canada gives the precipitation at various points throughout the central portion of the drainage, together with some few records of precipitation in the Rocky mountains:—

LENGTH OF RECORD.

Station.	Period.	From.	To.	Depth in inches.
Prince Albert	9 years	1903	1912	17·13
Saskatoon	9 "	1904	1912	14·15
McLeod	22 "	1884	1912	12·38
Calgary	27 "	1885	1912	15·17
Edmonton	28 "	1883	1912	16·43
Banff	19 "	1891	1912	20·3
Fort Dunvegan	4 "	1905	1909	11·5

(*b*) *Discharge Measurements.*—Float discharge measurements were made in the year 1909 by E. A. Forward at Le Pas, and also at Grand rapids. This was followed by measurements made by the late William Ogilvie in the year 1911 at Grand rapids. On August 8, 1912, a gauging station was established at Grand rapids by the Manitoba Hydrographic Survey, and on October 21 of the same year, a second station was established at Le Pas. The results of discharge measurements made at these stations are given in tables No. 72 to 79. It is estimated that for the year 1913, a low flow of 5,000 second-feet occurred during the month of February at Le Pas, and while several lakes and a great area of low-lying swampy land occurs between this point and Grand rapids, which should give some regulation of the flow at the latter point, yet it has been assumed that a minimum flow of 5,000 second-feet also occurred at Grand rapids. During July of 1913 a flood discharge of approximately 64,000 second-feet was recorded at Le Pas.

K.—STORAGE POSSIBILITIES.

Three lakes are situated in the lower portion of the river system immediately above Grand rapids; through two of these lakes—Cedar and Cross lakes—the river flows, while Moose lake is a tributary to the north. The combined area of these three lakes is estimated to be 970 square miles, being made up as follows. Cross lake, 39; Cedar lake, 425; and Moose lake, 513 square miles. While there might be a possibility of storage on these lakes, investigations are at present being made as to the reclammation of low lands in the vicinity of Cedar lake through the lowering of the latter, which, if carried out, would forestall storage possibilities. Investigation is also being made as to the storage possibilities in the head-waters of the Saskatchewan river.

Making the assumption that the flow of the winter months from October 1, 1913, to April 1, 1914, would be similar to the same period during 1912-13, mass curve studies (*see* plate No. 30) show that a storage of 305 billions of cubic feet would be necessary for a uniform flow of 32,000 second-feet. A one-foot storage on Cross, Cedar and Moose lakes would give approximately 27 billion cubic feet, indicating that a storage slightly over 10 feet would be necessary to create a uniform flow for a period similar to that found year ending September 30, 1913.

M.—WATER-POWER.

An estimate of the power available at the three rapids (*see* plate No. 29), is given below. The power available has been based on an 80 per cent efficiency, and is also computed: First, for an estimated minimum flow of 5,000 second-feet; and second, for a flow of 34,000 second-feet, this being the lowest monthly mean flow for the six highest months of the year ending September 30, 1913, and extending from April to September, and the power as indicated refers only to this period.

No estimate has been made as to the additional power available during periods of low flow through any storage system:—

ESTIMATED Horse-power on 80 per cent Efficiency.

Possible Power Site.	Head in feet.	Min. Flow 5000 sec.-ft.	Period 6 mos. April—Sept. 34,000 sec.-ft.
		Horse-power.	Horse-Power.
Demi Charge	15	6808	46289
Red Rock	15	6808	46289
Grand Rapids	80	36305	246877

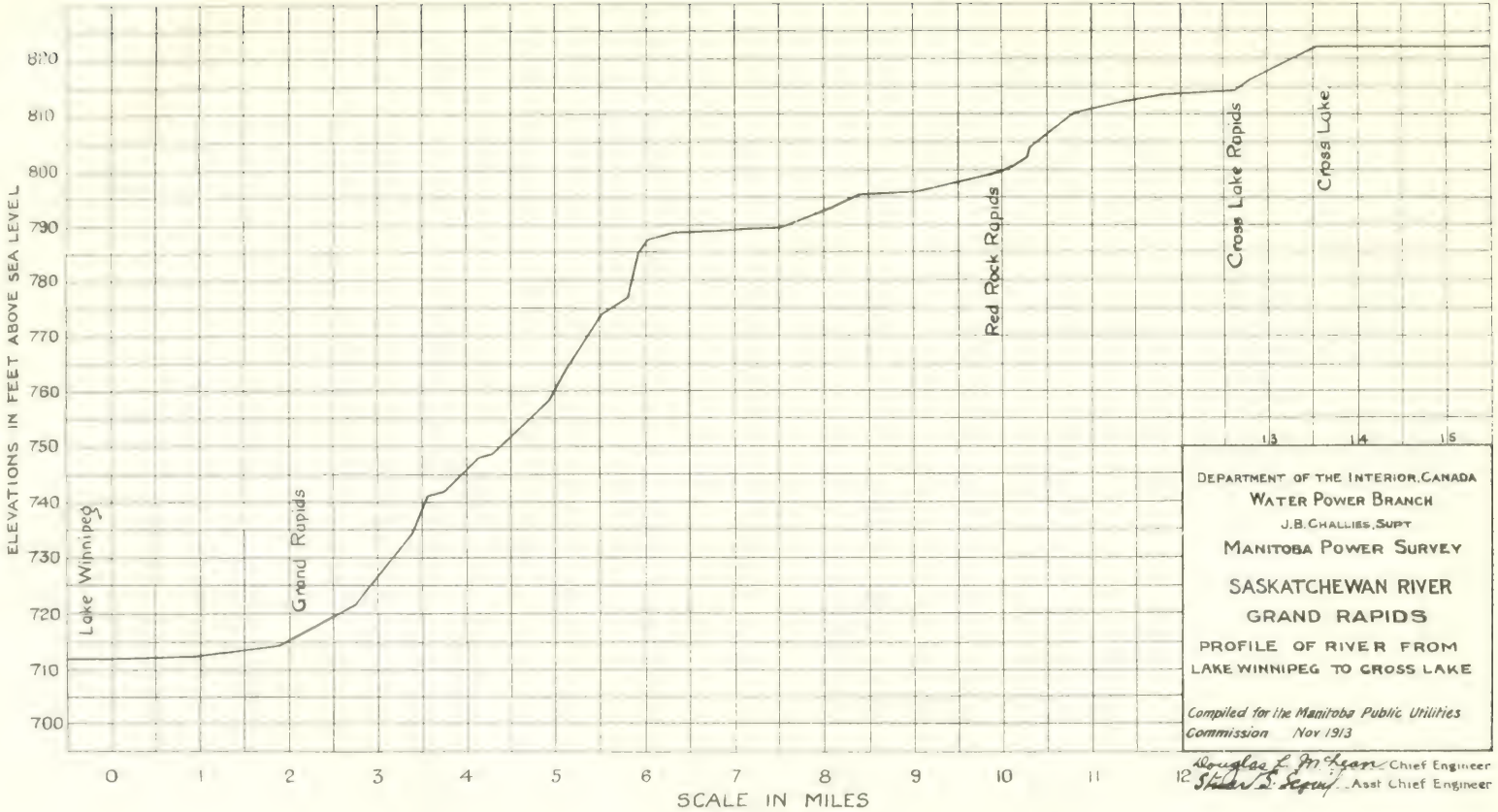
TABLE No. 72.

DISCHARGE MEASUREMENTS of Saskatchewan River, at Le Pas, Man., 1912 and 1913.
TABLE No. 72.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.
1912.			Feet.	Sq. ft.	Feet per sec.	Feet.	Sec.-ft.
Oct. 21-22	W. G. Worden	1196	914	18093	2·11		38123
Dec. 14	G. J. Lamb	1187	834	12848	0·68		[1]8772
1913.							
Feb. 8-9	A. Pirie	1469	771	9563	0·53		[1]5105
April 9	"	1186	775	10548	0·72		[1]7562
May 31	E. Bankson	1469	761	14233	3·10	9·46	45182
June 4	G. Ebner	1186	750	13331	3·31	9·37	44124
" 10	"	1186	750	13899	3·38	9·79	46979
" 12	"	1186	760	14041	3·51	10·14	49285
" 14	"	1186	739	14197	3·63	10·35	51534
July 10	"	1196	758	15446	3·69	11·98	56948
" 12	"	1196	760	15587	3·58	12·15	57743
" 15	"	1196	756	15848	3·79	12·37	60114
" 18	"	1196	756	16000	3·93	12·58	62883
" 21	"	1196	780	16066	3·98	12·76	63970
" 23	"	1196	673	16107	3·86	12·80	62120
" 25	"	1196	756	16309	3·93	12·91	64199
" 28	"	1196	750	16342	3·91	12·96	63869
" 30	"	1196	756	16332	3·85	12·94	63025
Aug. 1	"	1196	756	16311	3·82	12·85	62385
" 4	"	1196	756	16146	3·84	12·65	62029
" 6	"	1196	756	16043	3·75	12·50	60357
" 28	W. J. Ireland	1469	774	15229	3·62	11·41	55101
Sept. 20	"	1469	720	13422	3·03	8·98	40707
Oct. 9	C. O. Allen	1435	648	11040	2·50	6·07	27582
" 23	"	1435	648	11171	2·15	6·35	[2]24025
Nov. 18	A. Pirie	1496	830	12938	0·92	3·70	[1]11890

1. Ice measurement.
2. Ice running in river.

PLATE 29



DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
J.B. CHALLIES, SUPT
MANITOBA POWER SURVEY

SASKATCHEWAN RIVER
GRAND RAPIDS

PROFILE OF RIVER FROM LAKE WINNIPEG TO CROSS LAKE

Compiled for the Manitoba Public Utilities Commission Nov 1913

Douglas F. McLean Chief Engineer
Stuart S. Scott Asst Chief Engineer

TABLE No. 73.

Daily Gauge Height and Discharge, Saskatchewan River, at Le Pas, Man., for 1913.

(Drainage area, 149,500 Square Miles.)

Day.	April.		May.		June.		July.		August.		September.		October.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.
	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	...	...	12·30	60,090	9·45	44,985	11·50	55,850	12·85	63,005	11·35	55,055	...	...
2	...	...	·30	60,090	·40	44,720	·50	55,850	·80	62,740	·24	54,472	...	...
3	...	...	·30	60,090	·30	44,190	·60	56,380	·70	62,210	·10	53,730	...	...
4	...	...	·20	59,560	·40	44,720	·70	56,910	·65	61,945	11·00	53,200	...	...
5	...	...	·24	59,772	·35	44,455	·80	57,440	·60	61,680	10·90	52,670	...	...
6	...	...	12·25	59,825	9·30	44,190	11·80	57,440	12·50	61,150	10·86	52,458	...	...
7	...	...	·20	59,560	·30	44,190	·85	57,705	·50	61,150	·86	52,458	...	...
8	...	...	·40	60,620	·50	45,250	·83	57,599	·40	60,620	·70	51,610	6·30	28,290
9	...	...	·60	61,680	·60	45,780	·90	57,970	·30	60,090	·50	50,550	·12	27,336
10	...	...	·80	62,740	·80	46,840	·90	57,970	·20	59,560	·26	49,278	5·95	26,435
11	...	...	11·20	54,260	9·80	46,840	12·00	58,500	12·25	59,825	10·20	48,960	5·95	26,435
12	...	...	·30	54,790	10·00	47,900	·10	59,030	·25	59,825	·00	47,900	·58	24,474
13	7·2	33,060	·50	55,850	·20	48,960	·40	60,620	12·00	58,500	9·90	47,370	...	...
14	·3	33,590	·60	56,380	·35	49,755	·30	60,090	11·90	57,970	·75	46,575	...	...
15	·4	34,120	·70	56,910	·40	50,020	·40	60,620	·90	57,970	·60	45,780	...	...
16	9·25	43,925	11·50	55,850	10·50	50,550	12·40	60,620	11·90	57,970	9·30	44,190	...	...
17	10·20	48,960	·30	54,790	·60	51,080	·50	61,150	·80	57,440	·17	43,501	...	...
18	·90	52,670	10·20	48,960	·70	51,610	·60	61,680	·70	56,910	·04	42,812	...	...
19	11·20	54,260	·25	49,225	·90	52,670	·60	61,680	·60	56,380	·10	43,130	...	...
20	12·20	59,560	·23	49,119	11·00	53,200	·70	62,210	·50	55,850	·05	42,865	...	...
21	11·65	56,645	10·30	49,490	11·00	53,200	12·80	62,740	11·40	55,320	8·54	40,162	...	...
22	·50	55,850	·20	48,960	·00	53,200	·80	62,740	·40	55,320	·42	39,526	...	...
23	·60	56,380	·00	47,900	·90	57,970	·80	62,740	·35	55,055	·34	39,102	...	...
24	·70	56,910	9·60	45,780	·80	57,440	·80	62,740	·40	55,320	·25	38,625	...	...
25	·90	57,970	·50	45,250	·70	56,910	·90	63,270	·40	55,320	·14	38,042	...	...
26	12·00	58,500	9·55	45,515	11·60	56,380	12·95	63,535	11·40	55,320	7·81	36,293	...	...
27	12·20	59,560	·50	45,250	·50	55,850	·95	63,535	·39	55,267	·74	35,922	...	...
28	·20	59,560	·40	44,720	·50	55,850	·95	63,535	·43	55,479	·20	33,060	...	...
29	·35	60,355	·50	45,250	·50	55,850	13·00	63,800	·40	55,320	...	...	...	...
30	...	...	·50	45,250	·50	55,850	12·90	63,270	·40	55,320	...	...	...	...
31	...	...	·50	45,250	...	...	·90	63,270	·30	54,790	...	...	...	...

TABLE No. 74.

DISCHARGE MEASUREMENTS of Saskatchewan River, at Grand Rapids, Man., 1909.

Date.	Hydrographer.	Width.	Area of Section.	Mean Velocity.	Discharge.
1909.		Feet.	Sq. ft.	Ft. per sec. (89·2%.)	Sec.-ft.
Oct. 21....	F. A. Forward.	876	5714	4·84	24669

NOTE.—Above rapids. No wind. Surface floats. Mean of five good results taken course=1100 ft. Mean time for course=227.4 sec. Surface rate of flow=4.84 ft./sec. Ratio mean to surface flow=89.2 for rough contoured rock bottom. H. W. level six feet above present level. Flood section=1,114 sq. ft. Probable rate of flow=6 ft./sec. The maximum discharge=66,684 sec.-ft.

TABLE No. 75.

DISCHARGE MEASUREMENTS of Saskatchewan River, at Grand Rapids, Man., 1910.

Date.	Hydrographer.	Meter No.	Width.	Area of Section.	Mean Velocity.	Gauge Height.	Discharge
1910.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
July.....	Wm. Ogilvie.....		1048	13341	2·65	786·22	35322
Oct.....	Wm. Ogilvie.....		.....	.....	.....	.....	24433

NOTE.—Taken on section late used by W.P.S. Approximative elevation of gauge=786.22.

TABLE No. 76.

DISCHARGE MEASUREMENTS of Saskatchewan River, at Grand Rapids, Man., 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Aug. 8.....	E. B. Patterson.....	285	1,055	15,061	3·47	788·18	52,262
Sept. 18.....	E. B. Patterson.....	3	1,056	15,853	4·01	788·96	63,570
" 23.....	E. B. Patterson.....	3	1,058	15,957	3·98	789·06	63,510

TABLE No. 77.

DISCHARGE MEASUREMENTS of Saskatchewan River, at Grand Rapids, Man., 1913.

Date.	Hydrographer	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Aug. 27	A. Pirie	1,496	1,054	15,422	3·71	788·31	57,206
" 29	A. Pirie	1,497	1,054	15,485	3·57	788·36	55,266
" 30	A. Pirie	1,497	1,054	15,427	3·55	788·29	54,718
Nov. 10	A. Pirie	1,496	1,016	11,872	1·66	786·01	19,727
" 11	A. Pirie	1,496	1,012	11,963	1·71	785·97	20,548

TABLE No. 78.

DAILY GAUGE HEIGHT AND DISCHARGE, Saskatchewan River, near Head of Grand Rapids, for 1912.

Day.	AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			788·79	62,000		65,000		38,750
2			·84	62,750		65,000		38,750
3	787·88	48,500	·80	62,000		65,000		38,750
4		49,000	·74	61,250		65,000	787·23	38,750
5	787·93	49,250	·77	61,250		65,000		38,750
6	788·00	50,000	788·89	63,500		65,000		37,250
7	·04	50,750	789·11	66,500	789·02	65,000		35,750
8	·13	52,250		66,250		66,500		34,250
9	·21	53,000		66,000		68,000		32,750
10		51,500	789·06	65,750		69,500		31,250
11		50,000	788·99	65,000		71,000	786·67	29,750
12		48,500	·99	65,000		72,500		29,000
13		47,000	789·07	65,750		74,000		28,250
14	787·82	47,000	788·96	64,250	789·69	74,000		27,500
15		47,000	·98	65,000		74,000		26,750
16		47,000	788·99	65,000		74,000		26,000
17		47,750	·94	64,250		74,000		25,250
18		47,750	·96	64,250		72,500	786·28	24,500
19	787·83	47,750	·98	65,000		72,500		24,500
20		47,750	789·01	65,000		72,500		24,500
21		47,000	788·99	65,000	789·50	72,500		23,750
22	787·79	47,000	789·01	65,000		67,250		23,750
23		50,750	·10	66,500		62,000		23,000
24		54,500	·06	65,750		56,750		23,000
25		57,500	788·96	64,250		51,500	786·22	23,000
26	788·74	61,250		64,250		46,250		
27		61,250		64,250		41,000		
28		61,250		64,250	787·29	39,500		
29		61,250		64,250		39,500	785·15	
30		62,000		64,250		39,500		
31		62,000				39,500		

TABLE No. 79.

DAILY GAUGE HEIGHT AND DISCHARGE, Saskatchewan River, near Head of Grand Rapids, Man., for 1913.

Day.	MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.	
	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.	Gauge Height.	Discharge.
	Feet.	Sec. ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec. ft.	Feet.	Sec. ft.	Feet.	Sec.-ft.
1				48,500		46,500		54,500		53,000		39,950		24,500
2			787·89	48,500		46,500		54,500	788·19	53,000		39,500		23,900
3				48,500		46,500		54,500		52,550		39,050		23,300
4				48,500		47,500	788·29	54,500		52,100		38,600		22,700
5				47,500		47,500		54,500		51,650		38,150		22,100
6				47,500		47,500		54,500		51,200		37,700		21,500
7				46,500	787·89	48,500		54,500		50,750		37,250	786·12	21,500
8				46,500		48,500		56,000		50,300		36,800	·06	20,750
9			787·69	45,500		48,500		56,000		49,850		36,350	·25	23,750
10				45,500		48,500		56,000		49,400		35,900	785·95	19,250
11				45,500		47,000	788·39	56,000		48,950		35,450	785·96	19,250
12				45,500		47,000		56,000		48,500		35,000	·91	
13				45,500		47,000		56,000		48,050	786·99	35,000	·06	
14				45,500	787·79	47,000		56,000		47,600	·97	34,250	784·95	
15				45,500		48,000		54,500		47,150	·96	34,250	·78	
16			787·69	45,500		49,000		54,500		46,700	786·92	33,500		
17				45,500		50,000		54,500		46,250		33,500		
18				45,500		51,000	788·29	54,500		45,800		32,900		
19	786·99	35,000		45,500		52,000		54,500		45,350		32,300		
20		37,250		45,500		53,000		55,250		44,900		31,700		
21		39,500		45,500	788·28	54,500		55,250		44,450		31,100		
22		41,750		45,500		54,500		56,000		44,000		30,500		
23		44,000	787·69	45,500		54,500		56,000		43,550		29,900		
24		46,250		45,500		54,500		56,000		43,100		29,300		
25		48,500		45,500		56,000		56,750		42,650		28,700		
26	787·99	50,000		45,500		56,900	788·45	56,750		42,200		28,100		
27		50,000		45,500		56,000	788·33	55,250		41,750		27,500		
28		50,000		45,500	788·39	56,000		55,250		41,300		26,900		
29		50,000		45,500		56,000	788·33	56,000		40,850		26,300		
30		48,500	787·69	45,500		56,000	·31	54,500		40,400		25,700		
31		48,500				56,000		54,500				25,100		

PLATE 30

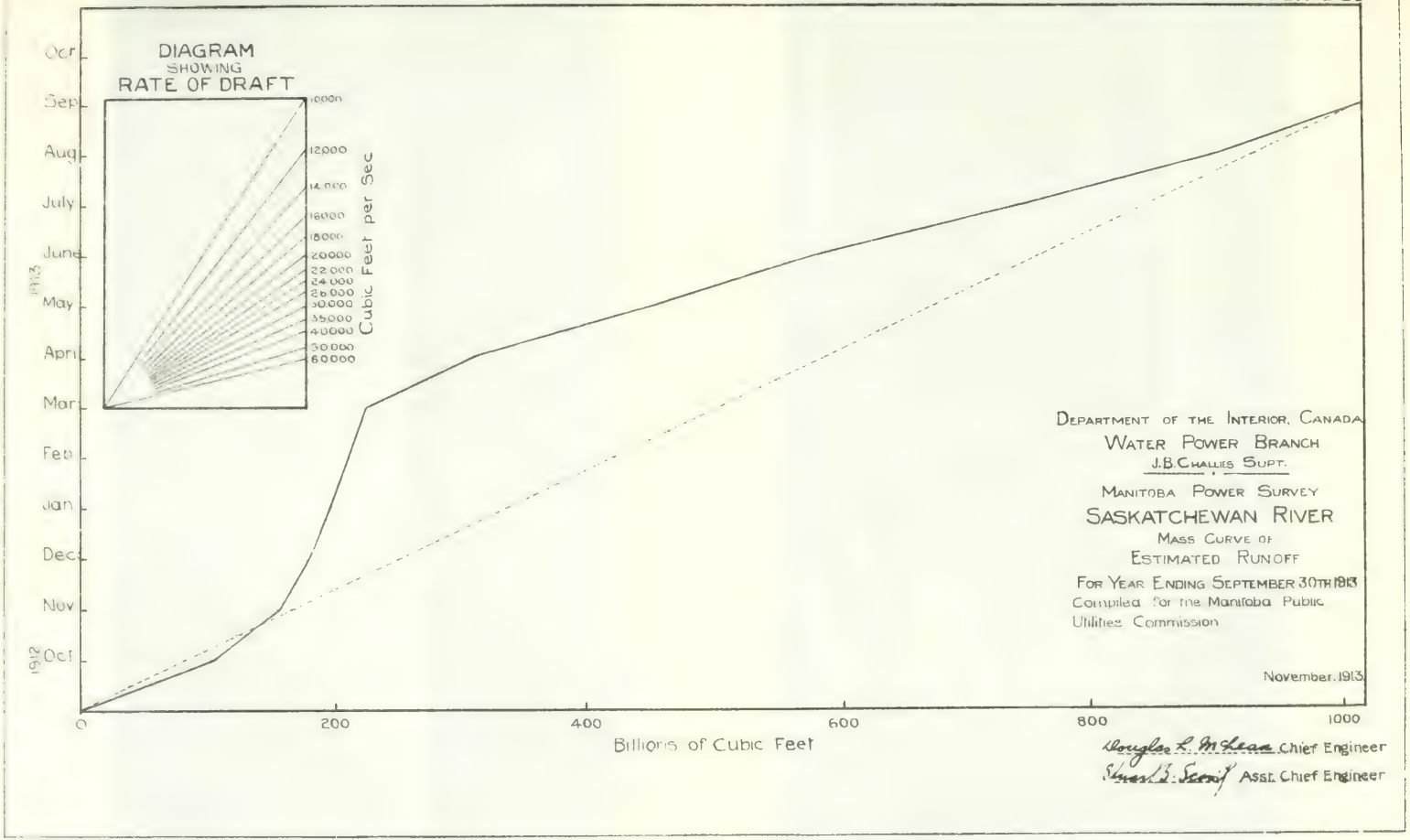


DIAGRAM
SHOWING
RATE OF DRAFT
10000
12000
14000
16000
18000
20000
22000
24000
26000
30000
35000
40000
50000
60000
Cubic Feet per Sec
Oct
Sep
Aug
July
June
May
Apr
Mar
Feb
Jan
Dec
Nov
Oct
1913
1912
0
200
400
600
800
1000
Billions of Cubic Feet
DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
J.B. CHALLIES SUPT.
MANITOBA POWER SURVEY
SASKATCHEWAN RIVER
MASS CURVE OF
ESTIMATED RUNOFF
FOR YEAR ENDING SEPTEMBER 30TH 1913
Compiled for the Manitoba Public
Utilities Commission
November, 1913.
Douglas L. McLean Chief Engineer
Edward J. Scott Asst. Chief Engineer

Oct: 6th 1912
C.317
Saskatchewan River - Grand Rapids - Red Rock

Oct: 6th 1912
C.315
Saskatchewan River - Grand Rapids

from boat in Grand Rapids

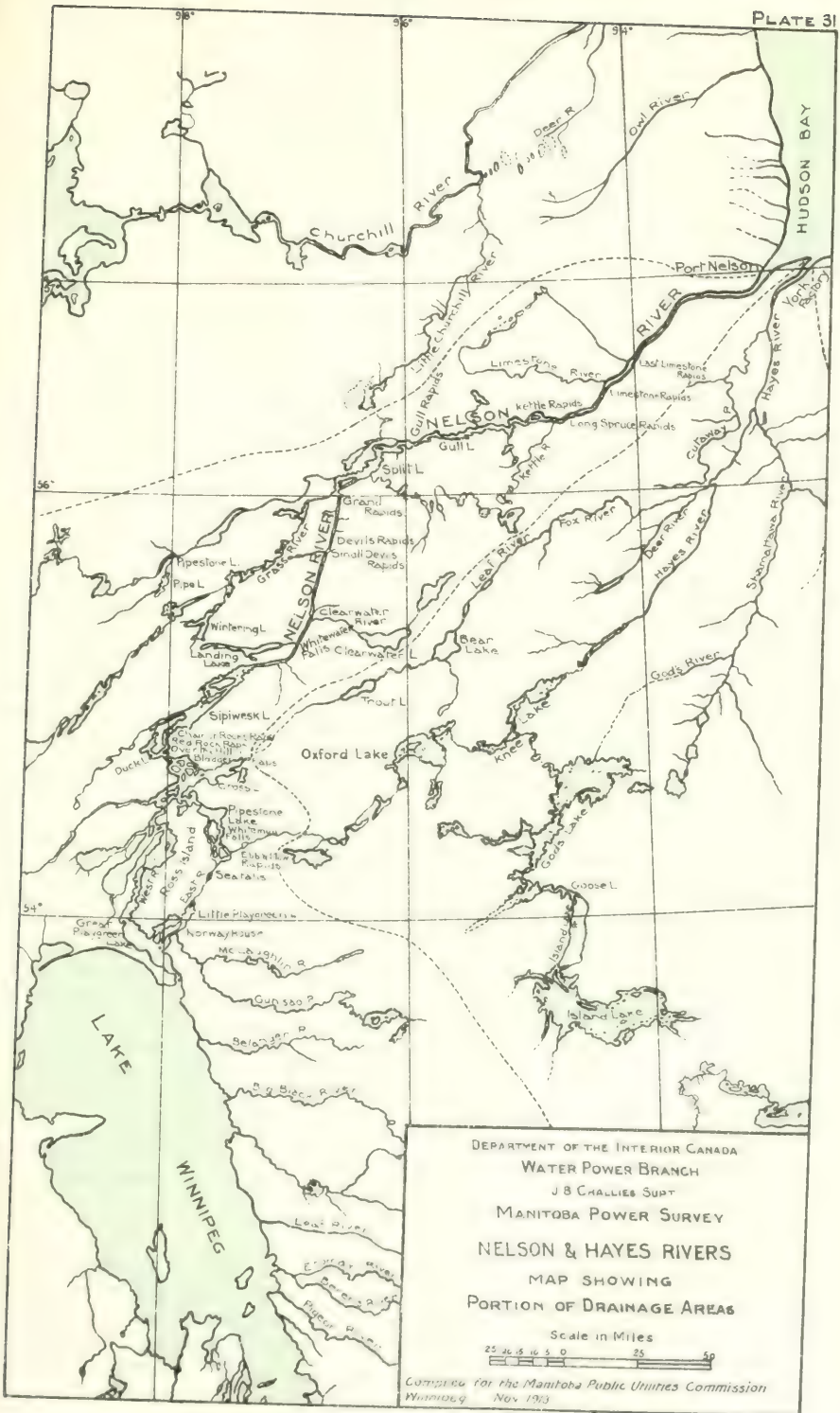
Saskatchewan River - Le Pas Showing ... 1901 + 1905

WATER-POWERS OF MANITOBA

CHAPTER VIII

RIVERS IN NORTHERN PORTION OF MANITOBA

PLATE 31



DEPARTMENT OF THE INTERIOR CANADA
WATER POWER BRANCH
J B CHALLIES SUPT
MANITOBA POWER SURVEY

NELSON & HAYES RIVERS

MAP SHOWING
PORTION OF DRAINAGE AREAS

Scale in Miles
25 20 15 10 5 0 25 50

Compiled for the Manitoba Public Utilities Commission
Winnipeg Nov. 1913

Douglas L. McLean Chief Engineer
Stuart S. Stuart Asst Chief Engineer

CHAPTER VIII

RIVERS IN NORTHERN PORTION OF MANITOBA

Nelson River.

A.—LOCATION.

The Nelson river (*see* plate No. 31) flows through the central portion of northern Manitoba. Heading in the northerly end of lake Winnipeg, the river flows in a general northeasterly direction, discharging into the southwest corner of Hudson bay.

B.—RIVER BASIN.

The Nelson river, being the outlet of lake Winnipeg, discharges the waters collected by this lake from an immense drainage area. It is one of the first or main drainage systems of the northern continent, having a tributary area of some 450,000 square miles. This vast area extends from the height of land slightly west of lake Superior to the Rocky mountains. To the north, the basin is bounded by the Athabaska and Churchill rivers, while the southern drainage extends down into the Northern States. Rivers tributary to lake Winnipeg and having immense areas of tributary drainage in themselves, comprise such systems as the Winnipeg, Red, Dauphin and Saskatchewan rivers. Numerous smaller rivers, including the Berens, Pigeon, Manigotagan and Brokenhead also contribute to the flow from lake Winnipeg.

Practically a complete range of physical characteristics or conditions is found throughout the basin, comprising as it does the drainage from the eastern slopes of the Rocky mountains and ranging from this to the prairie section of Western Canada, and again farther eastward to the rocky and hummocky country of the Laurentian Plateau. Similarly, there is a vast difference in the nature of the vegetation and forest growth.

The drainage directly tributary to the Nelson is small in extent as compared to that tributary to lake Winnipeg, but it includes the following rivers: Burntwood, Limestone, Kettle and several smaller streams.

Due to the tremendous expanse of lake Winnipeg and of its tributary systems of great lakes, comprising lakes Manitoba and Winnipegosis, practically a natural regulation of the flow of the Nelson river results, and the range between flood and minimum discharge cannot be high. In this respect, the Nelson river is similar to the St. Lawrence, in that the flow of the latter has a natural regulation through the action of the Great lakes.

C.—GENERAL DESCRIPTION OF RIVER.

The length of the river from lake Winnipeg to Hudson bay, as determined by a survey made by Dr. Otto J. Klotz, is 430 miles. In this distance a drop of some 700 feet occurs. In the upper reaches, the river could more properly be described as a chain of lakes connected by falls or by reaches of river and rapids. In this upper portion of the river extending approximately, to Split lake, some 250 miles from lake Winnipeg, the banks are in general higher than found on the lower portion. Although

the river, as stated, expands in this upper section into many lakes of practically ponded or of slow-running water, yet the falls are more sharply defined and usually of steeper descent than found in the lower reaches, and at the same time are often separated by islands into numerous narrow channels. Not only are the banks lower as lake Winnipeg is approached, but the distance between them becomes greater. The descent, also, is not so abrupt, being more often a series of rapids or swift running water. These latter characteristics gradually become more accentuated as Hudson bay is approached.

Expanding into Playgreen lake a short distance below lake Winnipeg, the river flows from the former lake through two main branches separated by Ross island, and known as the East and West rivers. The East river, on which occurs Sea River falls, is narrowed at many points by islands, although later it expands into Pipestone lake. The West river is wider and is navigable by steamboat to Whisky Jack portage, which is in the vicinity of the junction of the two branches at Cross lake. From this lake to Sepewesk lake, the river at first flows between islands and drops through the Ebb and Flow rapids, followed by the Whitemud falls. The Bladder rapids follow, in which the river flows in one narrow channel. Below this rapids, the river again divides into two main channels before lake Sepewesk is reached. On the eastern channel, three rapids are met with; Over the Hill, Red Rock and Chain of Rock rapids. Below Sepewesk lake to the Manitou or Devils rapids, the river is more contracted and retains this feature until it reaches Split lake. In the reaches above this lake is Grand rapids, followed very closely by Chain of Islands rapids. Birthday or Overfall rapids follows in the stretch of river to Gull lake. Below this latter lake, the river expands and is divided by islands with the formation of Gull, Kettle and Long Spruce rapids. From Long Spruce rapids to Hudson bay, in which stretch the Limestone rapids occurs, the river is generally wider and freer of islands.

D.—NATURE OF BANKS.

Throughout the extent of the river, rock outcrops are stated to occur at practically all rapids. The soil overlying the rock is principally clay, with some deposits of gravel and boulders. The banks at the location of rapids range in height from some 10 to 70 feet in the upper portion of the river, but become generally lower as the mouth of the river is approached.

E.—TIMBER AND VEGETATION.

A scattered growth of timber, including spruce, birch and poplar occurs along the river. The clay soil overlying the rock formation is stated to be very fertile, and root crops are grown at Norway House, Cross lake and Split lake. Wheat is also stated to have been grown at the two former places.

F.—HIGH AND LOW WATER.

High water is stated to take place during mid-summer, while the period of low water is usually in the late winter months. It is also stated that the extreme range between these two periods is never more than six feet.

G.—TRANSPORTATION.

Steamboats at present navigate the Nelson river from lake Winnipeg to Whisky Jack portage, but below this point navigation is only possible in certain portions of the river. The river is not crossed at any point by railroad, but at several points is in the vicinity of the new Hudson Bay railway.

H.—SURVEYS OF THE RIVER.

Numerous surveys of the river have been made for various purposes. In the year 1878, Dr. Robert Bell made a geological survey from lake Winnipeg to the mouth of the river. A similar survey was made in the year 1902 by Mr. J. B. Tyrrell of the Geological Survey. In the interests of navigation, a reconnaissance survey was made by the Department of Public Works of Canada in the fall of 1909. From the report on this work, considerable data, including a profile of the river, has been obtained for the present report. Surveys carried on by the Water Power Branch of the Department of the Interior, include a reconnaissance of the power possibilities of the upper portion of the river, by the late William Ogilvie in the year 1910, and also discharge measurements of the East and West rivers during the season of 1913.

I.—RUN-OFF.

(*a*) *Rainfall.*—As no rainfall records are available for the greater portion of the drainage area, it would be impossible to estimate what the mean for the whole area would be. The following table gives the mean annual rainfall for certain stations lying within the basin. It will be noted that there is a wide range in the precipitation.

Station	Period of Record		Term in Years	Precipitation in Inches
	From	To		
Winnipeg, Man.	1873	1912	40	21·6
Kenora, Ont.	1886	1912	9	22·4
Channel Island (Lake Winnipeg)	1890	1903	13	17·1
Norway House, Man.	1896	1904	8	18·9
Moorhead, Minn.	1881	1908	28	24·9
Prince Albert, Sask.	1903	1912	9	17·1
Edmonton, Alta.	1883	1912	28	16·4
Calgary, Alta.	1886	1909	23	18·6
McLeod, Alta.	1896	1912	15	13·6
Banff, Alta.	1893	1912	19	20·3

(*b*) *Discharge Measurements.*—Some few miscellaneous discharge measurements have been made on the Nelson river, though none of these measurements, however, apparently determine the low flow of the river. Discharge measurements made by Mr. William Ogilvie in the latter part of August, 1910, in the vicinity of Whitemud walls, indicate a discharge of 109,364 second-feet. Mr. Miles, of the Department of Public Works, obtained a discharge measurement at the outlet of Sepewesk lake on October 6, 1909, at what was stated to be a very low stage of the river, this resulting in a flow of 118,369 second-feet. In September, 1913, measurement of the flow of the East and West rivers were made by Alexander Pirie of the Manitoba Hydrographic Survey. On September 16, 1913, the total flow of the East river below Sea River falls was 19,762 second-feet. On September 25, the flow on the West river in the vicinity of Whisky Jack portage was 46,549 second-feet. At the time of metering the West river a storm from the northwest lowered the level of lake Winnipeg at its northerly end which undoubtedly greatly decreased the flow.

J.—STORAGE POSSIBILITIES.

As stated previously, any extreme variation in the flow of the Nelson river is hardly possible, due to the immense expanse of lake area at the head of the river. The vast area of lake Winnipeg offers unexcelled facilities for a storage which should

completely regulate the flow of the river. The lake comprises an area of 9,414 square miles, and in extent ranks fifth in superficial area of the lakes of North America; it is over 2,000 square miles larger than lake Ontario and slightly less than lake Erie. The following table gives an estimate of the flow which a storage of only 2 feet would render available for periods of either 3 months, 6 months or a year:—

Depth of Storage	Storage in Billions of Cu. Ft.	Rate of Draft in second-feet.		
		Period 3 Months	Period 6 Months	Period 1 Year
1 foot.	262·30	33·260	16 630	8315
2 "	524·60	66·520	33·260	16630

K.—WATER-POWER.

The following table gives an estimate of power available on the Nelson river at various points of concentration (*see* plate No. 32). As no detailed investigation of the river's power possibilities has as yet been made, the head available is subject to revision. The estimate has been based on a minimum flow of 50,000 second-feet, computed for an efficiency of 80 per cent. The estimate of minimum flow is also subject to verification or revision as future records of the Manitoba Hydrographic Survey will show. No estimate has been made for the additional power available through regulated flow from lake Winnipeg:—

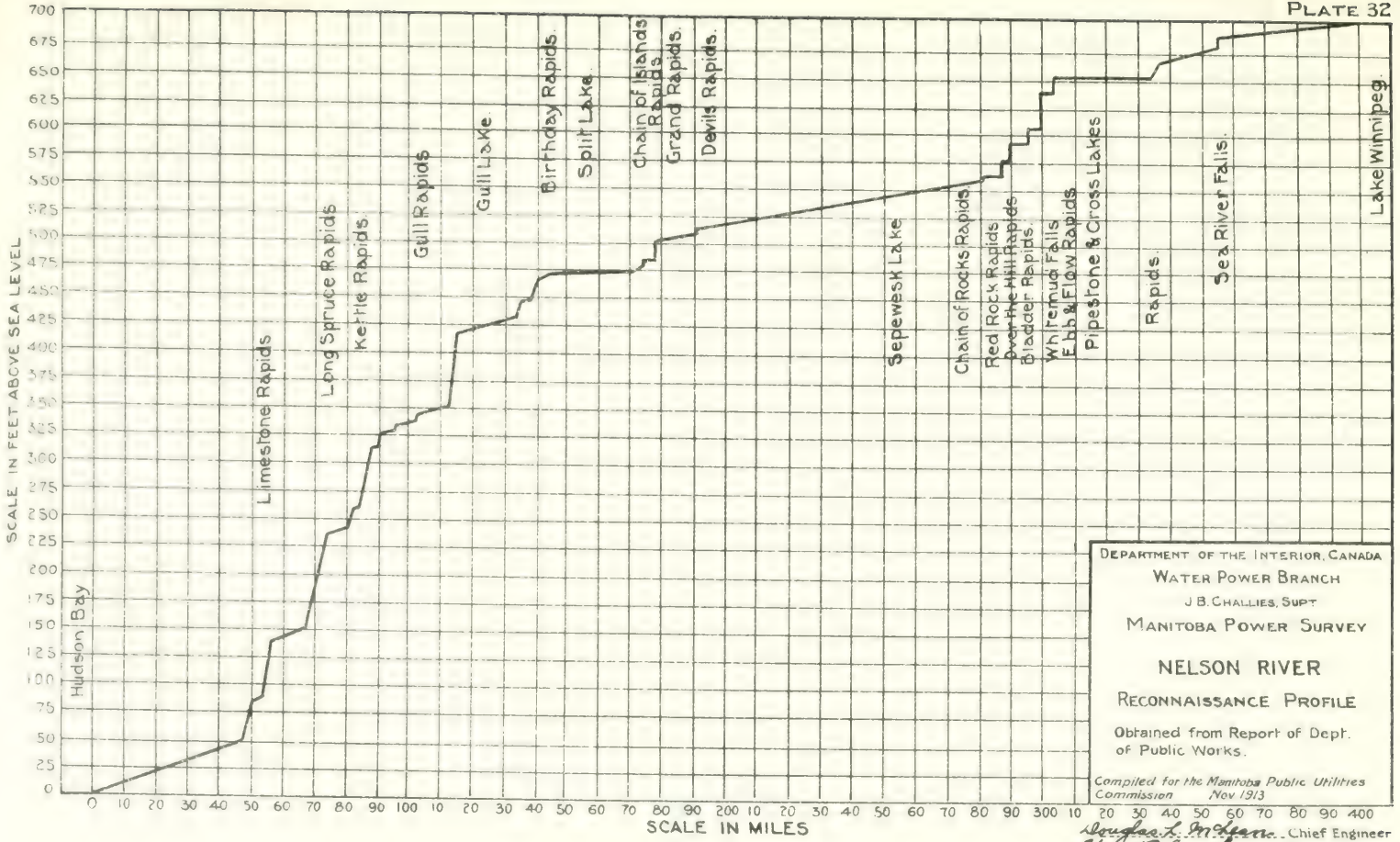
Possible Power Site.	Heads.	Estimated Horse-power based on minimum flow of 50,000 second feet at 80 per cent efficiency.
	Feet.	Horse-power.
Whisky Jack portage	40	181,150
Ebb and Flow rapids	17	77,150
White Mud rapids	30	135,860
Bladder	20	90,575
Chain of Rocks rapids	35	158,510
Devils rapids	25	113,220
Grand rapids	27	122,530
Birthday rapids	36	163,375
First Gull rapids	17	77,150
Second " rapids	21	95,105
Third " rapids	20	90,575
Fourth " rapids	30	135,860
First Kettle rapids	17	77,150
Second " rapids	21·5	97,370
Third " rapids	40	181,150
Upper Long Spruce rapids	40	181,150
Lower Long Spruce rapids	52	235,495
Upper Limstone rapids	33	149,450
Lower Limestone rapids	41	185,680
Total		2,548,505

Hayes River.

A.—LOCATION.

The Hayes river (*see* plate No. 31) is situated in the central portion of northern Manitoba. Rising slightly to the east of the northerly end of lake Winnipeg, the river flows in a northerly direction, discharging into Hudson bay.

PLATE 32



DEPARTMENT OF THE INTERIOR, CANADA

WATER POWER BRANCH

J B. CHALLIES, SUPT

MANITOBA POWER SURVEY

NELSON RIVER

RECONNAISSANCE PROFILE

Obtained from Report of Dept. of Public Works.

Compiled for the Manitoba Public Utilities Commission Nov. 1913

Douglas L. McLean ..... Chief Engineer

Stibbard Scovil ..... Asst. Chief Engineer

B.—RIVER BASIN.

The Hayes river drains a basin 36,250 square miles in extent, which lies between the drainage of the Nelson and Severn rivers. The first fifteen miles of the lower portion of the river could more properly be called an inlet of Hudson bay, as very little drop is stated to take place in this distance. Some 6 miles above this inlet, the junction of the Nelson and Cutaway rivers occurs, while some 35 miles further upstream there enters a tributary, known as the Shamattawa river, which in extent is practically of the same size as the Hayes. The Shamattawa river could more properly be stated to comprise in its source the head-waters of the drainage. While the Shamattawa carries the drainage from the country east of the Hayes river, the Fox river, entering some 40 miles above, drains the western portion of the area. Between these two rivers lies the Hayes river itself, which discharges several large lakes lying in the vicinity of the northern end of lake Winnipeg. The basin is dotted with many lakes varying in size from small ponds to lakes of large extent, such as Oxford lake, Gods lake and Island lake. The upper portion of the watershed in which these lakes are located is stated to be broken and hilly with the occurrence of many rock outcrops.

C.—GENERAL DESCRIPTION OF RIVER AND BASIN.

From the outlet to the mouth of the Fox river, the Hayes is comparatively wide, with shallow water, and for the most part low banks, although the latter increase in height at some few places. In the reach of the river extending some 35 miles above Fox river the banks become gradually higher, and the river has a uniform width of about 250 feet. It is stated that four rapids of gradual descent are located in this stretch of river. Many rapids with a fall of from 3 to 6 feet each occur above this, in that portion of the river below Knee lake. Above Knee lake the Hayes river consists of a chain of lakes connected by short stretches of very swift water, often broken by rapids or falls.

D.—TIMBER AND VEGETATION.

Along the main river the land is stated to be of good clay soil, with a varied growth of poplar and spruce, while at Oxford House, in the vicinity of Oxford lake, excellent cereal and root crops are grown.

E.—SETTLEMENTS.

There are two small settlements in the drainage basin, one being at York Factory, situated at the mouth of the river, while the other is at Oxford House on the north-east shore of Oxford lake.

F.—RUN-OFF.

(*a*) *Precipitation.*—No records of precipitation are available for the drainage area, but it is estimated that there is a mean annual precipitation of some 19 inches, this latter being based on an eight-year record at Norway House, which is situated at the northerly end of lake Winnipeg.

(*b*) *Discharge Measurements.*—No discharge measurements of the total flow of this river have as yet been made. Assuming the mean annual run-off of 0·3 second-feet per square mile for a drainage area of 36,250 square miles would give a mean annual discharge of 10,875 second-feet. No estimate is made as to the minimum flow of this river, but considering the great extent of lake area lying within the basin, the range between flood and minimum flow should not be great.

G.—WATER-POWER.

While no detailed investigations have as yet been made of the power available on this river, yet it is stated that at many points in the river there is a possibility of power concentrations. The elevation of Island lake lying at the head-waters of the Shamattawa river is stated to be 900 feet above sea-level, which would indicate a drop of this extent occurring between the head-waters and the mouth. In the reaches of the river above the junction of the Fox and extending to the upper lakes, the average descent is stated to be over 8 feet per mile, and it is in this section of the river that the banks are of sufficient height to permit of power concentration at many points.

Churchill River.

A.—LOCATION.

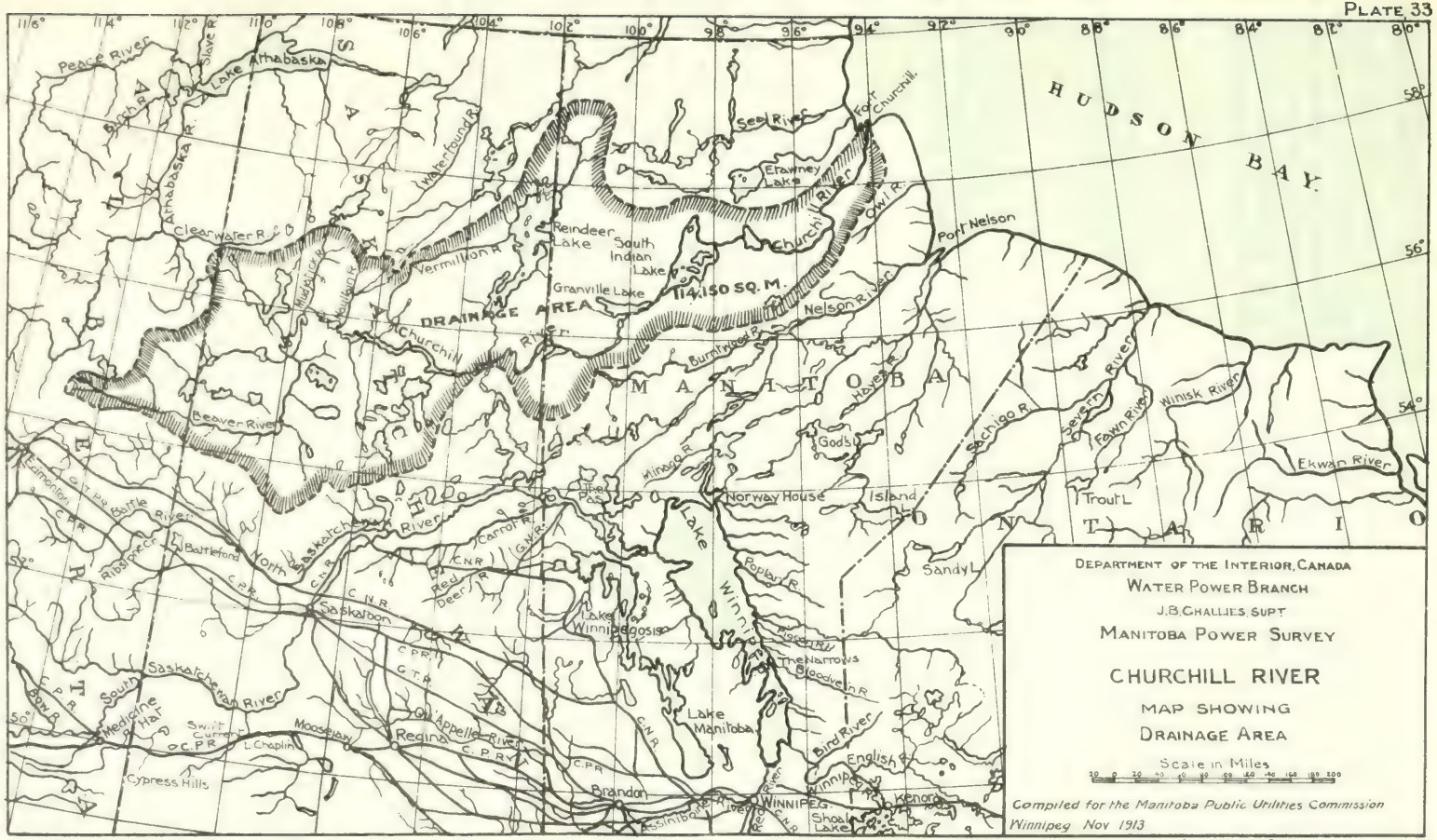
The Churchill river (*see* plate No. 33) flows in an easterly direction across the western provinces until the Manitoba boundary is reached. At this point the river bends to the north and the course through Manitoba is in this latter direction to the mouth of the river on the southwestern shore of Hudson bay.

B.—RIVER BASIN.

The basin drained by the Churchill is 114,150 square miles in extent. It lies to the north of the Saskatchewan drainage and heads in the vicinity of the Athabaska river. In the lower reaches in the vicinity of Hudson bay the river is situated to the north of the Nelson river and roughly parallels the course of the latter. The general nature of the basin is altogether the opposite of that found in the lower region drained by the Saskatchewan. Innumerable lakes of varying size occur throughout the whole basin, and a great portion of the river itself could more properly be described as a chain of lakes joined by short stretches of river, or in some cases only by a fall from one lake to another. Due to the occurrence of these many lakes and the angles at which the flow passes through them, the river presents a very irregular appearance. Of the main streams tributary to the Churchill, those entering from the north comprise the Reindeer river, which heads in Reindeer lake, and which is practically the largest lake throughout the basin, and, in itself, has considerable tributary drainage comprising many smaller lakes. Above the junction of this river there enters the Trout, Foster, Haultain and Mudjatik rivers, together with many smaller streams. The Churchill itself heads in Ile à la Crosse lake, tributary to which and lying to the north are Buffalo and Cedar lakes, into the former of which lake la Loche is drained by la Loche river. A second tributary entering the southerly end of Ile à la Crosse heads in several small lakes which constitute the extreme head-waters of the drainage and are situated in the vicinity of Lac la Biche in the province of Alberta. The main tributaries entering the Churchill from the south and below the Beaver river, are the Sandy, Montreal, Burntwood and Little Churchill rivers. Practically all the tributaries to the Churchill either discharge from or through numerous lakes of varying size, and throughout the basin many rapids and falls occur.

In the southern portion of the drainage, large areas of good agricultural clay are stated to be overlying the rock formation, but to the north the extent of the rock outcrop increases greatly.

From Fort Churchill, situated at the mouth of the river, for approximately 80 miles upstream the Churchill is stated to be free from formidable rapids, the banks in this stretch being of clay and, at places, both high and steep. Above this to North Indian lake, which is situated about midway in the course of the river through



DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
J.B. CHALLIES, SUPT.
MANITOBA POWER SURVEY

CHURCHILL RIVER
MAP SHOWING DRAINAGE AREA

Scale in Miles

Compiled for the Manitoba Public Utilities Commission
Winnipeg Nov 1913

Douglas L. McLean ... Chief Engineer
Sidney E. Scott ... Asst. Chief Engineer

Manitoba, the river widens out at two points, into two small lake expanses. Numerous rapids occur in this stretch. Some 30 miles west of North Indian lake the river discharges through South Indian lake with two rapids in the intervening reach. A short distance above the southern lake, the river again widens into Granville lake, followed a short distance upstream by Nelson lake and again by Puklatawagan, Loon and Sissipuk lakes, the latter lake being situated approximately on the Manitoba boundary.

C.—SETTLEMENTS.

No extensive settlements are situated in the vicinity of the river, though there are many trading posts and missions scattered throughout the district.

D.—NAVIGATION AND ACCESSIBILITY.

The Churchill is stated to be navigable only by canoe, due to the many rapids necessitating portages, yet is acessible at the mouth by steamer from Hudson bay. No railroads are situated in the immediate vicinity of the river.

E.—WATER-POWER.

As a power possibility the Churchill river offers a magnificent field for investigation. While no survey of this nature has yet been made of either the portion in Manitoba or in the reaches outside the province, it is known that considerable fall occurs throughout the extent of the river. Reindeer lake, which is drained by Reindeer river, a tributary to the Churchill some 60 miles west of the Manitoba boundary, is at an elevation of 1,150 feet above sea-level, indicating a drop of that extent between the above-mentioned lake and the mouth of the river. Ile à la Crosse in the vicinity of the head-waters is at an elevation of 1,330 feet, while Knee lake, a considerable distance to the eastward, is 1,250 feet above sea-level. Not only is there an indication of considerable fall on the river, but also the numerous and extensive lake areas indicate, not only great natural regulation of the flow, but also the possibilities of further regulation through systems of storage on some of the larger lakes.

No discharge measurements have as yet been made on this river, nor is there anything definite known as to the precipitation. Assuming, however, a mean annual run-off of 0·3 second-feet per square mile, this would give a mean annual discharge of some 34,000 second-feet.

Department of the Interior, Canada
HONOURABLE W. J. ROCHE, MINISTER
W. W. CORY, C.M.G. DEPUTY MINISTER
Water Power Branch
J. B. CHALLIES, SUPERINTENDENT
MANITOBA POWER SURVEY
MAP SHEWING
WATER POWERS OF SOUTHERN MANITOBA
Scale of Miles
LEGEND
Power Sites Developed
Power Sites to be Investigated
Present Power Developments
Proposed Power Developments
Meteorological Stations
River or Lake Gauges
Mountain Interprovincial Drainage Areas
Lines of Equal Rainfall
Wind Roses
Transmission Lines
SASKATCHEWAN
MANITOBA
ONTARIO
LAKE OF THE WOODS

WATER-POWERS OF MANITOBA.

CHAPTER IX.

REGULATIONS GOVERNING THE GRANTING OF WATER-POWER PRIVILEGES

IN

MANITOBA, SASKATCHEWAN, ALBERTA AND THE NORTHWEST TERRITORIES

CHAPTER IX.

WATER-POWER REGULATIONS UNDER THE DOMINION LANDS ACT. SEC. 35, S.S. 2.

REGULATIONS made by His Excellency the Governor General in Council in virtue of the provisions of subsection 2 of section 35 of the Dominion Lands Act, 7-8 Edward VII, chapter 20, as amended by section 6 of chapter 27, 4-5 George V, to govern the mode of granting water-power rights in the provinces of Manitoba, Saskatchewan and Alberta, and the Northwest Territories.

Section 35, Dominion Lands Act. Water-powers.

35. Lands which are necessary for the protection of any water supply or lands upon which there is any water-power, or which border upon or being close to a water-power will be required or useful for the development and working of such water-power, shall not be open to entry for homestead, for purchased homestead, or pre-emption, or be sold or conveyed in fee by the Crown, but may only be leased under regulations made by the Governor in Council.

(2) Subject to rights which exist or may be created under the Irrigation Act, the Governor in Council may make regulations: (*a*) for the diversion, taking or use of water for power purposes, and the granting of the rights to divert, take and use water for such purposes, provided that it shall be a condition of the diversion or taking of water that it shall be returned to the channel through which it would have flowed if there had been no such diversion or taking, in such manner as not to lessen the volume of water in the said channel; (*b*) for the construction on or through Dominion or other lands or sluices, races, dams or other works necessary in connection with such diversion, taking or use of water; (*c*) for the transmission, distribution, sale and use of power and energy generated therefrom; (*d*) for the damming of and diversion of any stream, watercourse, lake or other body of water for the purpose of storing water to augment or increase the flow of water for power purposes during dry season; (*e*) for fixing the fees, charges, rents, royalties or dues to be paid for the use of water for power purposes, and the rates to be charged for power or energy derived therefrom.

(3) Any person who under such regulations is authorized to divert, take or use water for power purposes, or to construct works in connection with the diversion, taking or use of water for such purposes, shall for the purposes of his undertaking have the powers conferred by the Railway Act upon railway companies, including those for the acquisition and taking of the requisite lands, so far as such powers are applicable to the undertaking and are not consistent with the provisions of this Act or the regulations thereunder, or with the authority given to such persons under such regulations—the provisions of the said Railway Act giving such powers being taken for the purposes of this section to refer to the undertaking of such person where in that Act they refer to the railway of the railway company concerned.

(4) All maps, plans and books of reference showing lands other than Crown land necessary to be acquired by any such person for right of way or other purposes in connection with his undertaking shall be signed and certified correct by a duly qualified Dominion Land Surveyor.

(5) Such maps, plans and books of reference shall be prepared in duplicate and one copy thereof shall be filed in the office of the Minister at Ottawa, and the other shall be registered in the land titles office for the registration district within which the lands affected are situated.

(6) The Minister, or such officer as he designates, shall in case of dispute be the sole and final judge as to the area of land which may be taken by any person without the consent of the owner for any purpose in connection with any water-power undertaking.

REGULATIONS GOVERNING THE GRANTING OF WATER-POWER RIGHTS IN THE PROVINCES OF MANITOBA, SASKATCHEWAN AND ALBERTA, AND THE NORTHWEST TERRITORIES.

(Established by Orders in Council dated June 2, 1909, June 8, 1909, April 20, 1910, January 24, 1911, and August 2, 1913.)

1. Under these regulations the word 'works' shall be held to mean and include all sluices, races, dams, weirs, tunnels, pits, slides, flumes, machines fixed to the soil, buildings and other structures for taking, diverting and storing water for power purposes, or for developing water-power and rendering the same available for use.

MODE OF APPLICATION.

2. Every applicant for a license to take and use water for power purposes shall file with the Minister of the Interior a statement in duplicate setting forth:—

(*a*) The name, address and ocupation of the applicant.

(*b*) The financial standing of the applicant so far as it relates to his ability to carry out the proposed works.

(*c*) The character of the proposed works.

(*d*) The name, or if unnamed, a sufficient description of the river, lake or other source from which water is proposed to be taken or diverted.

(*e*) The point of diversion.

(*f*) The height of the fall or rapid of such river, lake or other source of water at high, medium and low stages, with corresponding discharges of water per second, reckoned approximately in cubic feet.

(*g*) A reasonably accurate description, and the area, of the lands required in connection with the proposed works, such lands, if in surveyed territory, to be described by section, township and range, or river or other lot, as the case may be, and a statement whether such lands are or are not Dominion lands.

(*h*) If such lands be not Dominion lands, then the applicant shall give the name of the registered owner in fee, and of any registered mortgagee or lessee thereof, and of any claimant in actual possession other than a registered owner, mortgagee or lessee.

(*i*) The minimum and maximum amount of water-power which the applicant proposes to develop, and the maximum amount of water which he desires for such purpose.

(*j*) Sketch plan showing approximate locations of the proposed works.

(*k*) Elevations of head water and tail water of the nearest existing works, if any, below and above the proposed works.

(*l*) Particulars as to any water to be taken, diverted or stored to the detriment of the operation of existing works, if any.

(*m*) Particulars as to any irrigation ditches or reservoirs, or other works for irrigation within the meaning of the Irrigation Act, in use or in course of construction within the vicinity of the proposed works, and which might affect or be affected by the operation of the proposed works.

APPLICATION BY A COMPANY.

3. If the applicant be an incorporated company, the statement shall, in addition to the foregoing information, set forth:—

(*a*) The name of the company.

(*b*) The names of the directors and officers of the company, and their places of residence.

(*c*) The head office of the company in Canada.

(*d*) The amount subscribed and paid-up capital, and the proposed method of raising further funds, if required, for the construction and operation of the proposed works.

(*e*) Copy of such parts of the charter or memorandum of association as authorize the application and proposed works.

APPLICATION BY A MUNICIPALITY.

4. If the applicant be a municipality, then, excluding the special information to be given by a company, the following information shall be given:—

(*a*) The location, area and boundaries of the municipality.

(*b*) The approximate number of its inhabitants.

(*c*) The present estimated value of the property owned by such municipality, and the value of the property subject to taxation by such municipality.

MINISTER MAY REQUEST FURTHER INFORMATION.

5. The Minister of the Interior shall have the power to call for such other plans and descriptions, together with such measurements, specifications, levels, profiles, elevations and other information as he may deem necessary, and the same shall be furnished by and at the expense of the applicant.

THE AGREEMENT FOR A LICENSE.

6. Upon receipt and consideration of the application, and information accompanying same, the Minister of the Interior may, if he approve of the proposed works, enter into an agreement with the applicant, which agreement, in addition to usual conditions and covenants, shall contain clauses to provide as follows:—

(*a*) For a time within which the proposed works shall be begun.

(*b*) For a stated minimum amount of expenditure to be made in connection with the works annually during the term of the agreement.

(*a*) For a stated amount of water-power to be developed from the water applied for within a fixed period not exceeding five years.

(*d*) For summary cancellation of the agreement by the Minister if any of the above conditions have not been complied with.

(*e*) For defining and allotting the areas of Dominion lands within which the applicant may construct and operate the proposed works; and if there be no Dominion lands available for such purpose then for defining and allotting the lands in regard to which the applicant may exercise the powers given under section 35, subsection 3 of the Dominion Lands Act.

(*f*) For granting a license to the applicant, upon fulfilment of the said agreement, to take, divert and use for power purposes a stated maximum amount of water, in accordance with the application, and plans and specifications as approved by the Minister; the terms of such license to be twenty-one years at a fixed fee, payable annually, and such license to be renewable as provided for in these regulations.

(*g*) For granting a lease to the applicant of such Dominion lands as may be allotted under paragraph (*e*) of this section, and approved of by the Minister, such lease to be at a fixed rental for a term of twenty-one years running concurrently with the said license, and renewable in like manner, and as near as may be subject to all the terms and conditions thereof. When there are no Dominion lands available for such purpose, or when other lands are considered by the Minister to be more suitable

for such purpose, then the Minister shall define such lands in regard to which the applicant may exercise the powers given under section 35, subsection 3, of the Dominion Lands Act.

7. During the construction of any works for the development of water-power, the Minister of the Interior, or any engineer appointed by him for that purpose, shall have free access to all parts of such works for the purpose of inspecting same, and ascertaining if the construction thereof is in accordance with the plans and specifications approved of by the Minister, and whether the terms of the agreement, as provided for in the preceding section, are beng fulfilled.

THE LICENSE.

8. Upon fulfilment by the applicant of all conditions of the said agreement, the Minister of the Interior shall grant to the applicant a license as agreed upon; and such license shall contain clauses to provide as follows:—

(*a*) The term of the license shall be twenty-one years, renewable for three further consecutive terms of twenty-one years each, at a fixed fee payable annually, and to be readjusted at the beginning of each term, as hereunder provided.

(*b*) At the expiry of each term of twenty-one years the Governor in Council, may, on the recommendation of the Minister, order and direct that the license and any lease granted in connection therewith be cancelled: Provided that the Minister shall have given at least one year's notice to the licensee of intention so to cancel.

(*c*) If the licensee shall refuse to pay the license fee as readjusted by the Governor in Council, or as fixed by arbitrators chosen as provided in paragraph (*e*) hereunder, then in such case the Minister may renew the license at the former fee, or the Governor in Council may, on the recommendation of the Minister, order and direct that the license and any lease issued in connection therewith be cancelled.

(*d*) In either of the above cases compensation shall be paid to the licensee as provided for in paragraph (*e*) hereunder.

(*e*) On termination of the third renewal of such license, except in case of default on the part of the licensee in observance of any of the conditions thereof, or of any license granted in connection therewith, compensation shall be paid for the works to the amount fixed by arbitration, one arbitrator to be appointed by the Governor in Council, the second by the licensee, and the third by the two so appointed. If the licensee fails to appoint an arbitrator within ten days after being notified by the Minister to make such appointment, or if the two arbitrators appointed by the Governor General in Council and the licensee fail to agree upon a third arbitrator within ten days after their appointment or within such further period as may be fixed by the Minister in either such cases such arbitrator or third arbitrator, as the case may be, shall be appointed by the Judge of the Exchequer Court of Canada. In fixing the amount of compensation only the value of the actual and tangible works and of any lands held in fee in connection therewith shall be considered, and not the value of the rights and privileges granted, or the revenues, profits or dividends, being, or likely to be, derived therefrom.

(*f*) The license shall state the maximum amount of water which the licensee may divert, store and use for power purposes, and shall provide for the return to the stream, or other source of water, of the full amount so diverted.

(*g*) The licensee shall develop such power as, in the opinion of the Minister, there shall be a public demand for, up to the full extent possible from the amount of water granted by the license.

(*h*) Upon a report being made by the Minister of the Interior to the Governor in Council that the licensee has not developed the amount of power for which there is a public demand, and which could be developed from the amount of water granted by the license, the Governor in Council may order to be developed and rendered avail-

able for public use the additional amount of power for which there is, in the opinion of the Minister, a public demand, up to the full extent possible from the amount of water granted by the license, and within a period to be fixed by the Minister, which period shall not be less than two years after the licensee or person in charge of the existing works shall have been notified of such order, and in default of compliance with such order the Governor in Council may direct that the license, together with any lease issued under these regulations shall be cancelled, and the works shall thereupon vest and become the property of the Crown without any compensation to the licensee.

(*i*) Upon a report being made by the Minister of the Interior to the Governor in Council that a greater amount of water-power could be developed advantageously to the public interests from the same stream or other source of water from which the existing works derive power, and (1st) that the existing works could be enlarged or added to for such purpose, then the Governor in Council may authorize the Minister to offer the licensee the privilege of constructing and operating such enlarged or additional works at or in the vicinity of the existing works, and to grant such supplementary license as he may consider proper for such purpose, and if the licensee fail within six months thereafter to accept such offer, and in good faith to begin and carry on to completion such enlarged or additional works, and to complete same in acordance with plans and specifications approved of by the Minister, and within a fixed period not to exceed five years, and upon like conditions as the existing works were begun and completed; or (2nd) if the Minister shall report to the Governor in Council that the existing works, owing to their location or construction, cannot advantageously be enlarged or added to in order to develop further power sufficient to meet the probable demand, or would be a hindrance to other works contemplated for such purpose; or (3rd) that the existing works cannot, or will not, be any longer advantageously operated owing to the exercise of rights existing or created under the Irrigation Act; then in every such case, the Governor in Council may order and direct that the license, and any lease in connection therewith, and all rights thereunder, shall be cancelled, and the existing works shall thereupon vest in and become the property of the Crown: Provided always that in every such case compensation shall be paid to the licensee as provided for in paragraph (*e*) of section 8 of these regulations, together with a bonus apportioned as follows:—

(1) If the works have been in operation less than five years, a thirty per cent bonus upon the value of the works.

(2) If in operation more than five, and less than ten years, a twenty-five per cent bonus.

(3) If in operation more than ten, and less than fifteen years, a twenty per cent bonus.

(4) If in operation more than fifteen, and less than twenty years, a fifteen per cent bonus.

(5) If in operation twenty years or more, a ten per cent bonus.

(*j*) That the license shall not be transferable without the written consent of the Minister, and that if the licensee fail to keep and observe all or any of the conditions of the license, or any renewal thereof, or of any lease to be issued in connection therewith, then the license, together with such lease, shall in every such case be subject to cancellation by the Exchequer Court on the application of the Crown.

(*k*) That a schedule of rates and prices to be charged to the public for the use of power shall first be submitted by the licensee to the Board of Railway Commissioners of Canada for adjustment and approval before being put into effect, and that no rates or prices for power shall be legal or enforceable until such schedule has been so adjusted and approved nor if they shall exceed the amount fixed by such schedule; and that such schedule shall be readjusted and approved by the Board every seven years during the term of the lease and license, and all renewals thereof.

(*l*) That for the purpose of ascertaining the quantity of power actually developed, or capable of being developed, from the amount of water granted by such license, the Minister, or any engineer appointed by him for that purpose, shall have free access to all parts of the works, and to all books, plans or records in connection therewith, bearing on the quantity of power developed, and may make measurements, take observations and do such other things as he may consider necessary or expedient for such purpose, and the findings of the Minister, or such engineer, thereon shall be conclusive and binding upon the licensee.

(*m*) For the proper provision, as required by law, for the passage of logs and timber down the stream or other waterway affected by the works.

(*n*) For the erection and maintenance by the licensee of a durable and efficient fishway in the stream or other waterway affected by the works when so required by the proper officer or authority in that behalf.

(*o*) That the licensee shall have no right to any water beyond the amount stated in the license.

(*p*) For the indemnifying of the Crown against all actions, claims or demands against it by reason of anything done by the licensee in the exercise, or purported exercise, of the rights and privileges granted under the lease or license.

9. The agreements and licenses to be issued hereunder shall, subject always to the provisions of these regulations, be in such form and contain such provisions as the Minister may from time to time determine.

STORAGE OF WATER.

10. If at any time it is proposed by the applicant or the licensee to divert water from any lake or body of water for storage purposes, or to dam same in order to augment the flow of water in any stream from which water-power is to be developed, the applicant or licensee shall, in addition to other information required under these regulations, file plans as follows:—

(*a*) A general plan in duplicate, on tracing linen, showing the location of such lake or other body of water, and the lands to be submerged or otherwise affected, and contour lines showing the water level at high and low stages, and the level to which it is proposed to raise such water for storage, and the estimated storage capacity of such lake or other body of water.

(*b*) A plan in duplicate, from actual survey, by a Dominion land surveyor, and certified to by him, showing the lands to be submerged or otherwise affected by the proposed storage; the name of the registered owner in fee of such lands, and of any registered mortgagee or lessee thereof, and of any claimant in actual possession other than a registered owner, mortgagee or lessee.

(*c*) A detail plan in duplicate on tracing linen, showing all dams and other works proposed to be constructed in connection with such storage.

11. When the plans for such storage of water have been approved of by the Minister of the Interior, provision for same shall be made in the agreement for a license, or in the license itself, or in a supplementary license to be issued for such purpose, upon such terms and conditions as may appear to the Minister reasonable or expedient in the circumstances of each case, and subject to these regulations.

SMALL WATER-POWERS OF LESS CAPACITY THAN 200 HORSE-POWER.

12. If upon receipt and consideration of the information set out in sections 2, 3, 4 and 5, the water-power to be developed is found to have no greater capacity than 200 horse-power at the average low stage of water, the Minister may issue a lease and a license as may be required, authorizing the development of the proposed power; the lease and license to be for a period of ten years, subject to such special terms and conditions as may be considered advisable in each particular case, and renewable if, in the opinion of the Minister, the power has been continuously and beneficially used.

DEPARTMENT OF THE INTERIOR, CANADA
WATER POWER BRANCH
J. B. Challies, Supt.

WATER RESOURCES PAPER No. 1.

REPORT

ON

RAILWAY BELT HYDROGRAPHIC SURVEY FOR 1911-12

BY

P. A. CARSON, D.L.S.
Chief Engineer

Prepared under the direction of the Superintendent of Water Power.

PRINTED BY ORDER OF PARLIAMENT

OTTAWA
PRINTED BY J. DE L. TACHE, PRINTER TO THE KING'S MOST EXCELLENT MAJESTY.
1914

To His Royal Highness, Field Marshal, Prince Arthur William Patrick Albert, Duke of Connaught and Strathearn, K.G., K.T., etc., etc., etc., Governor General and Commander-in-Chief of the Dominion of Canada.

MAY IT PLEASE YOUR ROYAL HIGHNESS:

The undersigned has the honour to lay before Your Excellency the report of the Hydrographic Survey of the Railway Belt, British Columbia for 1911-12.

Respectfully submitted,

W. J. ROCHE,
Minister of the Interior.

OTTAWA, February 28, 1914.

DEPARTMENT OF THE INTERIOR,

OTTAWA, Feb. 23, 1914.

The Honourable W. J. ROCHE,
Minister of the Interior.

SIR,—I have the honour to submit the report of the Hydrographic Survey of the Railway Belt, British Columbia, for 1911-12, and to recommend that it be published as Water Resources, Paper No. 1 of the Dominion Water Power Branch.

I have the honour to be, sir,
Your obedient servant,

W. W. CORY,
Deputy Minister of the Interior.

WATER POWER BRANCH,
DEPARTMENT OF THE INTERIOR,
OTTAWA, Feb. 23, 1914.

W. W. CORY, Esq., C.M.G.,
Deputy Minister of the Interior.

SIR,—I beg to submit herewith report of the Hydrographic Survey of the Railway Belt, British Columbia, for 1911-12, and would recommend that it be published as Water Resources, Paper No. 1 of the Dominion Water Power Branch, and that a sufficient number of copies be printed to permit of its being widely distributed among those interested in the question of the water supply of the province of British Columbia.

Respectfully submitted,

J. B. CHALLIES,
Superintendent, Dominion Water Power Branch.

HYDROGRAPHIC SURVEY, RAILWAY BELT, BRITISH COLUMBIA.

KAMLOOPS, Feb. 23, 1914.

SIR,—I have the honour to transmit herewith the manuscript of the report of Hydrographic Survey of the Railway Belt, British Columbia, for 1911-12. I beg to request that this manuscript be published as one of the Water Resources Papers of the Dominion Water Power Branch.

I have the honour to be, sir,
Your obedient servant,

P. A. CARSON,
Chief Engineer.

J. B. CHALLIES, Esq.,
Superintendent, Dominion Water Power Branch,
Department of the Interior,
Ottawa.

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PART I

THE RAILWAY BELT OF BRITISH COLUMBIA.

The Railway Belt of British Columbia is a strip of territory over 500 miles long and 40 miles wide, extending from the summit of the Rocky mountains (being the easterly boundary of the province) almost to the Pacific coast. The westerly limit of the Railway Belt is bounded by Mesliloet river, the North Arm of Burrard inlet, and the west boundaries of townships 39, 38, 2 and 1, west of Coast Meridian.

The Crown colony of British Columbia became part of the Confederation of the Dominion of Canada in 1871, under the provisions of section 146 of the British North America Act, 1867, which section provides for the admission into the union of other colonies. The date of admission was July 20, 1871, by an Imperial Order in Council, dated May 16, 1871.

Section 11 of the Terms of Union admitting British Columbia into Confederation is as follows:—

> "The Government of the Dominion undertake to secure the commencement, simultaneously, within two years from the date of the union, of the construction of a railway from the Pacific towards the Rocky mountains, and from such point as may be selected east of the Rocky mountains towards the Pacific, to connect the seaboard of British Columbia with the railway system of Canada; and, further, to secure the completion of such railway within ten years from the date of the Union.
>
> "And the Government of British Columbia agree to convey to the Dominion Government, in trust, to be appropriated in such manner as the Dominion Government may deem advisable in furtherance of the construction of the said railway, a similar extent of public lands along the line of railway throughout its entire length in British Columbia, not to exceed, however, twenty (20) miles on each side of said line, as may be appropriated for the same purpose by the Dominion Government, from the public lands in the Northwest Territories and the province of Manitoba. Provided that the quantity of land which may be held under pre-emption right or by Crown grant within the limits of the tract of land in British Columbia to be so conveyed to the Dominion Government, shall be made good to the Dominion from contiguous lands, and provided further, that until the commencement, within two years as aforesaid from the date of the union, of the construction of the said railway, the Government of British Columbia shall not sell or alienate any further portion of the public lands of British Columbia requiring actual residence of the pre-emptor on the land claimed by him. In consideration of the land to be so conveyed in aid of the construction of the said railway, the Dominion Government agree to pay to British Columbia, from the date of the union, the sum of 100,000 dollars per annum, in half-yearly payments in advance."

Although this conveyance was contemplated in 1871 by the aforesaid eleventh article of the Terms of Union, and a Provincial Act was passed in 1880 (43 Vict., chap. 11, assented to on May 8, 1880) looking to the transfer, the actual conveyance was not effected until the passing of a Provincial Act (assented to December 19, 1883), intituled "An Act relating to the Island Railway, the Graving Dock and Railway Lands of the Province" (47 Vict., chap. 14), and its confirmation by the Dominion by an Act assented to on April 19, 1884 (47 Vict., chap. 6).

Extracts of this Dominion Act, statutes of Canada, Fifth Parliament, are here given:—

"An Act respecting the Vancouver Island Railway, the Esquimalt Graving Dock, and certain Railway Lands of the Province of British Columbia, granted to the Dominion.

"Whereas negotiations between the Governments of Canada and British Columbia have been recently pending, relative to delays in the commencement and construction of the Canadian Pacific railway, and relative to the Vancouver Island railway, the Esquimalt Graving Dock, and certain railway lands of the province of British Columbia;

"And whereas, for the purpose of settling all existing disputes and difficulties between the two Governments, it hath been agreed as follows:—

"(*a*) The Legislature of British Columbia shall be invited to amend the Act number eleven, of 1880, intituled 'An Act to authorize the grant of certain public lands on the mainland of British Columbia to the Government of the Dominion of Canada for Canadian Pacific Railway purposes,' so that the same extent of land on each side of the line of railway through British Columbia, wherever finally settled, shall be granted to the Dominion Government in lieu of the lands conveyed by that Act;

"(*c*) The Government of British Columbia shall obtain the authority of the Legislature to convey to the Government of Canada three and one-half millions of acres of land in the Peace River district of British Columbia, in one rectangular block, east of the Rocky mountains and adjoining the North-West Territories of Canada.

"(*h*) The Government of Canada shall, with all convenient speed, offer for sale the lands within the Railway Belt upon the mainland, on liberal terms to actual settlers; and:—

"(*i*) Shall give persons who have squatted on any of the said lands, within the Railway Belt on the mainland, prior to the passing of the Act, and who have made substantial improvement thereon, a prior right of purchasing the lands so improved at the rates charged to settlers generally;

"(*k*) This agreement is to be taken by the province in full of all claims up to this date by the province against the Dominion, in respect of delays in the commencement and construction of the Canadian Pacific railway, and in respect of the non-construction of the Esquimalt and Nanaimo railway, and shall be taken by the Dominion in satisfaction of all claims for additional lands under the terms of Union, but shall not be binding unless and until the same shall have been ratified by the Parliament of Canada and the Legislature of British Columbia;

"And whereas the Legislature of British Columbia has, by an Act assented to on the 19th day of December, 1883, intituled 'An Act relating to the Island Railway, the Graving Dock and Railway Lands of the Province,' adopted the terms of the said agreement, and it is expedient that it should be ratified by the Parliament of Canada, and that provision should be made to carry out the terms thereof according to their purport;

"Therefore, Her Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:—

"1. The hereinbefore recited agreement is hereby approved and ratified.

"XI. The lands granted to Her Majesty, represented by the Government of Canada, in pursuance of the eleventh section of the Terms of Union, by the Act of the Legislature of the Province of British Columbia, number eleven of 1880, intituled 'An Act to authorize the grant of certain public lands on the mainland of British Columbia to the Government of the Dominion of

Canada for Canadian Pacific Railway purposes, as amended by the Act of the said Legislature, assented to on the 19th day of December, 1883, as aforesaid, intituled 'An Act relating to the Island Railway, the Graving Dock and Railway Lands of the Province' shall be placed upon the market at the earliest date possible, and shall be offered for sale on liberal terms to actual settlers;

"(2) The said lands shall be open for entry to bona fide settlers in such lots and at such prices as the Governor in Council may determine;

"(3) Every person who has squatted on any of the said lands prior to the 19th day of December, 1883, aforesaid, and who has made substantial improvements thereon, shall have a prior right of purchasing the lands so improved, at the rates charged to settlers generally;

"(4) The Governor in Council may, from time to time, regulate the manner in which and terms and conditions on which the said lands shall be surveyed, laid out, administered, dealt with and disposed of; Provided, that regulations respecting the sale, leasing or other disposition of such lands shall not come into force until they are published in the *Canada Gazette;*

"(5) The Act, 43rd Victoria, chap. 27, intituled 'An Act to repeal the Act extending 'The Dominion Lands Acts' to British Columbia, and to make other provision with respect to certain lands in that Province,' is hereby repealed.

"XII. The three and one-half million acres of lands in that portion of the Peace river district of British Columbia, lying east of the Rocky mountains, and adjoining the Northwest Territories of Canada, granted to Her Majesty, as represented by the Government of Canada, by the said Act assented to on the 19th day of December, 1883, as aforesaid, intituled 'An Act relating to the Island Railway, the Graving Dock and Railway Lands of the Province,' and to be located by the said Government in one rectangular block, shall be held to be Dominion lands within the meaning of the 'Dominion Lands Act, 1883.'"

Although the respective jurisdictions of the Federal Government and the several provincial legislatures seem to be clearly defined by sections 91 and 92 of the British North America Act, 1867, many doubts and controversies have arisen as to the interpretation of these sections; and the perplexing questions as they have appeared have been settled only by appeal to the highest courts: the Supreme Court of Canada and the Judicial Committee of the Privy Council. On British Columbia joining the Confederation, it would be natural that the ordinary cases of doubt as to jurisdiction should arise as in the other provinces; but to add to the ordinary complications, there was created right through the heart of the province a narrow strip of Dominion lands, transferred by the province to the Dominion "in trust."

In drawing up the Terms of Union it is evident that there could have been no anticipation of the store of trouble that afterward fermented regarding the question of jurisdiction over various matters in this Railway Belt: precious minerals, waters, fisheries, navigable streams, beds of streams, foreshores, and Indian Reserves.

During the past forty years in America, the value of water resources, for such purposes as water-power, irrigation, lumbering, mining, etc., has become more and more important. British Columbia, like so many other countries and states, soon found that the English common law of riparian rights was not only not applicable to conditions but was opposed to the best modern principles of agricultural and industrial development depending on the use and diversion of water.*

* Reference should be made to an exhaustive article on "Water Legislation and Administration in British Columbia," by H. W. Grunsky, page D. 117, of the Report of the Minister of Lands of British Columbia, 1912. In this article, Mr. Grunsky gives a résumé of all water legislation in British Columbia from the first departure from the doctrine of riparian rights, by Governor Douglas' "Goldfields Act," 1859, down to the present British Columbia Water Act of 1912. The present Water Act and its administration are also discussed.

"The Goldfields Act" (1859), the "Land Act," the "Placer Mining Act, 1891," and the "Mineral Act, 1896," authorized the diversion and use of water for various purposes. The "Water Privileges Act, 1892," declared all unrecorded and unappropriated water to be vested in the Crown, and that no right to the permanent diversion or exclusive use of any water should be granted or conferred except by the Crown. The "Water Clauses Consolidation Act, 1897," consolidated all previous Acts dealing with water and its uses.

The trouble up to that time, and even to 1909, was not so much with the statutes as with their administration, and the supervision and protection of rights granted under the laws, although, too, it was extremely difficult to keep the legislation apace with the changing conditions arising from rapid development.

In 1907 the water rights question all through British Columbia having become acute, a Commission of Investigation was appointed, and after its report the British Columbia Water Act of 1909 was evolved. In its preamble this Act says:—

> "Whereas, in the past, records of the right to divert and use water have been honestly but imperfectly made, resulting in confusion and litigation. And whereas it is desirable that the rights of existing users under former records should be properly declared."

The salient feature of the British Columbia Water Act is the creation of a tribunal, called the "Board of Investigation," whose duties are to hold sittings and hear claims of all persons holding or claiming to hold records of water or other water rights; to determine the priorities of the respective claimants; to prescribe the terms upon which new licenses shall be granted; to cancel old records, etc.

THE WATER RIGHTS SITUATION IN THE RAILWAY BELT.

The Government of the Province of British Columbia, even after it had transferred the Railway Belt to the Dominion, continued to administer water and water rights within the Belt, claiming, as in the precious minerals case, which was decided in favour of the Province, "that the Dominion Government held the Railway Belt only in trust for railway purposes, and had no right therein except as an ordinary grantee."

From time to time the Department of the Interior, both officially and unofficially, questioned the provincial claim to the jurisdiction over water within the Railway Belt, but the matter came to a head only in 1906, when certain Dominion timber concessionnaires holding timber interests on Lillooet lake protested to the Department of the Interior that their rights would be injuriously affected by a provincial water grant allowing the Burrard Power Company to divert some 25,000 miner's inches of water from Lillooet river for water-power purposes. These timber men maintain that this grant would render the river useless for lumber purposes, and they demanded that the Dominion Government should protect their rights. A test case was made of this—"The King versus The Burrard Power Company"—the Dominion claiming "that the provincial grant of water to the power company was invalid and conveyed no interest to the defendant company, and asking that the same should be cancelled." After filing the information, the Attorney General of British Columbia was added as a party to represent the interests of the province.

The Exchequer Court of Canada decided in favour of the Dominion, on May 10, 1909. From this judgment an appeal was brought to the Supreme Court of Canada. The appeal was dismissed on February 15, 1910.

The Attorney General of British Columbia took the decision to the final court of appeal, the Privy Council, and on November 1, 1910, the Judicial Committee gave judgment upholding the decision of the other two courts.

THE JUDGMENT OF THE JUDICIAL COMMITTEE OF THE PRIVY COUNCIL.

On account of its great importance, the full text is given of the Privy Council's decision in the appeal from the previous judgments in the King versus Burrard Power Company case:—

"This is an appeal, by special leave, from the judgment of the Supreme Court of Canada, affirming a judgment of the Exchequer Court of Canada rendered on the 10th May, 1909. The only question raised upon the appeal is whether certain water rights in the Railway Belt of British Columbia are vested in the Dominion Government so as to preclude the Provincial Legislature from dealing with them. The circumstances in which the dispute has risen are shortly as follow: The province of British Columbia was admitted into the Dominion of Canada in the year 1871 under the provisions of the British North America Act, 1867. The admission was subject to the provisions of that Act and also to certain Articles of Union duly sanctioned by the Parliament of Canada and by the Legislature of British Columbia. The eleventh of these articles stipulated that the Dominion Government should secure the construction of railway communication between the railway system of Canada and the seaboard of British Columbia, and that the Government of British Columbia should convey to the Dominion Government 'in trust, to be appropriated in such manner as the Dominion Government may deem advisable in the furtherance of the construction of the said railway,' certain public lands along the line of railway throughout its entire length in British Columbia. In consideration of the land to be so conveyed in aid of the construction of the said railway the Dominion Government agreed to pay to British Columbia from the date of the union the sum of $100,000 per annum. The conveyance contemplated by this part of the eleventh article was effected by subsequent statutes of the Legislature of the province, and the land so conveyed is known as the 'Railway Belt.' The railway has now been built. By the Water Clauses Consolidation Act, 1897, 61 Vict., chap. 190 (Revised Statutes of British Columbia), section 4, the right to the use of the unrecorded water in any river, lake, or stream was declared to be vested in the Crown in the right of the province, and it was enacted that save in the exercise of any legal right existing at the time of such diversions or appropriation no person should divert or appropriate any water from any river, watercourse, lake, or stream, excepting under the provisions of the Act. By section 5 it was provided that no right to the exclusive use of such water should be acquired by any person by length of use or otherwise than as might be acquired or conferred under the provisions of the Act or of some existing or future Act. By section 2 'water' was declared to mean all rivers and water-power not being waters under the exclusive jurisdiction of the Parliament of Canada and 'unrecorded water' was declared to mean all water not held under a record under the Act or under certain repealed Acts or under special grant by public or private Act, and should include all water for the time being unappropriated or unoccupied or not used for a beneficial purpose.

"On the 7th April, 1906, the Water Commissioners for the district of New Westminster, British Columbia, purporting to act under the provisions of this Act, granted to the appellants, the Burrard Power Company, Limited, at an annual rental of $566, a water record for 25,000 miner's inches of water out of the Lillooet lakes and the Lillooet river to be used for generating electricity. These waters are within the Railway Belt.

"On the 26th December, 1906, the Attorney General for the Dominion of Canada filed an information in the Exchequer Court of Canada against the

power company, claiming a declaration that the record was invalid and conveyed no interest to the defendant company and asking that the same should be cancelled. The information (which will be found set out on pages 717, 718 and 719 of the Record) alleged that the works of the power company if carried out would have the effect of diverting the water of the river, thereby interfering with its navigation, and would otherwise materially diminish the value of the lands of the Dominion Government in the Railway Belt. In support of the claim, reliance was placed on the agreement contained in the Terms of Union, and on the provisions of the Acts of the Provincial Legislature passed for the purpose of giving effect to that agreement. Reliance was also placed on the provisions of section 91 of the British North America Act, 1867, which declares that the exclusive legislative authority of the Parliament of Canada shall extend to all matters coming within certain classes of subjects, including the Public Debt and Property and Navigation. It was further submitted, that having regard to subsection 2 of section 131 of the Water Clauses Consolidations Act, 1897, the grant of the record by the Commissioners was not authorized by the Water Clauses Act.

"After the filing of the information the Attorney General of British Columbia was added as a party to represent the interests of the province.

"On the 23rd December, 1907, the determination of the issue of fact was referred for inquiry and report to Mr. Justice Archer Martin, who found the facts to be in accordance with the allegations of the Dominion Government, and reported accordingly. Thereupon the Attorney General of Canada prayed judgment as asked by the information. On the 13th April, 1909, the case came on for argument before Mr. Justice Cassels, and on the 10th May, 1909, that learned judge declared that the grant of the record of water in question was invalid and conveyed no interest to the defendant company. The judgment proceeded on three grounds: First, that the grant was an interference with property subject to the exclusive authority of the Dominion of Canada; secondly, that the diversion of water intended to be authorized thereunder would be a very serious interference with the navigability of the river; and thirdly, that the record was not authorized by the provisions of the Water Clauses Act under which it had been granted. The judgment as drawn up will be found at page 715 of the Record. From this judgment an appeal was brought to the Supreme Court of Canada. The appeal was dismissed on the 15th February, 1910.

"Their Lordships are of opinion that the judgments of the courts below are right. The grant by the province of British Columbia of public lands to the Dominion Government undoubtedly passed the water rights incidental to those lands. In the argument addressed to their Lordships this was not really questioned. But it was said that though the proprietary rights of the province in the land and in the waters belonging thereto were transferred to the Dominion Government, the legislative powers of the province over the same neither were nor could be parted with, and that therefore it was competent for the Provincial Legislature to enact the Water Clauses Act of 1897 under which the record was granted. In support of this contention a passage was cited from the judgment of Lord Watson in the Attorney General of British Columbia versus the Attorney General of Canada (1889), 14 Appeal Cases, p. 301. Their Lordships are of opinion that the contention is wrong, and that the passage in Lord Watson's judgment affords no kind of support for it. The object of article 11 of the Terms of Union was on the one hand to secure the construction of the railway for the benefit of the province and, on the other hand, to afford the Dominion a means of recouping itself in respect of the liabilities which it might incur in connection with the construction by sales to settlers of the land

transferred. To hold that the province after the making of such an agreement remained at liberty to legislate in the sense contended for would be to defeat the whole object of the agreement, for if the province could by legislation take away the water from the land it could also by legislation resume possession of the land itself; and thereby so derogate from its own grant as to wholly destroy it. Lord Watson's reference in the Precious Metals Case to the eleventh article, so far from supporting the appellants' contention is against it. He says: 'The conveyance contemplated was a transfer to the Dominion to the provincial right to manage and settle the lands and to appropriate their revenue.'

"The grant of the water record in the case now under consideration is an attempt on the part of the province to appropriate the revenues to itself, and would if carried into effect violate the terms of the contract as interpreted by Lord Watson. It is true that Lord Watson adds that the land is not by the transfer taken out of the province, and that once it is 'settled' by the Dominion it ceases to be public land, and 'reverts to the same position as if it had been settled by the Provincial Government in the ordinary course of its administration.' But this also is against the appellants' contention, for it implies that until settled by the Dominion it remains public land under Dominion's control.

"Their Lordships are of opinion that the lands in question, so long as they remain unsettled are 'public property' within the meaning of section 91 of the British North America Act, 1867, and as such are under the exclusive legislative authority of the Parliament of Canada by virtue of the Act of Parliament. Before the transfer they were public lands, the proprietary rights in which were held by the Crown in right of the province. After the transfer they were still public lands, but the proprietary rights were held by the Crown in right of the Dominion, and for a public purpose, namely, the construction of the railway. This being so, no Act of the Provincial Legislature could affect the waters upon the lands. Nor, in their Lordships opinion, does the Water Clauses Act of 1897 purport or intend to affect them; for, by clause 2, the Act expressly excludes from its operation waters under the exclusive jurisdiction of the Dominion Parliament.

"Their Lordships will humbly advise His Majesty that the appeal should be dismissed with costs."

There has seemed to be some matter of doubt as to the date on which the transfer of the Railway Belt from the province to the Dominion was effected. This date of transfer is of importance, as drawing the line before which all water records granted by the province within the Railway Belt are valid, and after which most records are invalid.

By some it has been contended that, by the 11th article of the Terms of Union (1871) the province surrendered at that date its powers of disposition over its lands, including waters, except to alienate by pre-emption. And, therefore, that all water records granted by the province subsequent to 1871, in the district afterwards defined as the "Railway Belt," are invalid. This seems to be the opinion of Judge Gregory, in the cases George vs. Mitchell, and George v. Humphrey, in the Supreme Court of British Columbia, 1911.

There is also an opinion that the province ceased to have any jurisdiction over waters in the Railway Belt after it passed the Act of 1880 (43 Vict., chap. 11; assented to May 8, 1880), and that only those water records granted prior to May 8, 1880, are valid.

It appeals against the judgments of Judge Gregory in the cases George vs. Mitchell, and George vs. Humphrey, in the British Columbia Court of Appeal, November 5, 1912, the appeals were allowed, the judges deciding that all water records granted by the province within the Railway Belt before April 19, 1884, are valid. Or, the province of British Columbia did not cease to have jurisdiction to alienate water

to settlers for irrigating purposes within what is now the "Railway Belt" until after the transfer effected by the Provincial Act, chap. 14, 1883 (assented to December 19, 1883) and confirmed by the Dominion Act, chap. 6, 1884 (assented to April 19, 1884).

DOMINION LEGISLATION NECESSITATED BY THE DECISION OF THE COURTS.

On account of this judgment by the Judicial Committee of the Privy Council in the King versus the Burrard Power Company case the opinion originally given for the guidance of the Minister of the Interior by the Dominion Department of Justice was upheld, viz., that the Railway Belt is the property of Canada within the meaning of section 91, paragraph 1, of the British North America Act, which assigns to the exclusive legislative authority of Parliament the public debt and property; consequently, the lands within the Railway Belt in British Columbia and all rights, including riparian and water rights connected therewith, which passed to the Dominion by the statutory grant of the province of British Columbia, and have not been transferred by the Dominion, are subject to the legislative jurisdiction of Parliament in the same manner and to the same extent as in the provinces of Manitoba, Saskatchewan and Alberta.

The then Minister of the Interior, Honourable Mr. Oliver, anticipating the judgment of the Privy Council, which would probably render necessary legislative action by Parliament to properly protect valid vested rights, and to provide machinery for administering water rights in the Railway Belt, introduced during the second session of the eleventh Parliament (1909-10), Bill No. 187, "An Act to confirm and declare the rights of the Crown for the Dominion with respect to water and water-power, and relating to the diversion, acquisition and use of water in the Railway Belt, British Columbia." This Bill, No. 187, received its first reading on March 23, 1910, but, although pressed by the Minister, opposition from different sources rendered necessary its withdrawal for that session.

Shortly after the Privy Council judgment was rendered (November 1, 1910), the Minister of the Interior, the Honourable Mr. Oliver, introduced in the third session of the eleventh Parliament, Bill No. 124 (short title, "The Railway Belt Water Act"), which was somewhat similar to the previous Bill. This Bill received its first reading on February 23, 1911, but on account of the press of business and the famous debate on the proposed reciprocity pact, its final consideration was delayed.

In November, 1911, the British Columbia Government prevailed upon the Dominion Government to transfer the administration over water rights in the Railway Belt to provincial control, the main arguments in favour of the transfer being that the province, albeit illegally, had administered the water for thirty years; that the water rights tangle was essentially a provincial responsibility, being of its own making; that the province already had an excellent Water Act, and was effecting an efficient administration; that one Water Act and one administration over the whole province would obviate the evils of a dual administration; and that the provincial water interests in the Belt were paramount, particularly as all lands and appurtenant rights escheated to the province upon passing into private hands.

Accordingly, "The Railway Belt Water Act" was passed by the Dominion Parliament, and assented to on April 1, 1912.

This Act is as follows:—

"2 GEORGE V., CHAP. 47.

"An Act respecting the Water in the Railway Belt and Peace River block of land.

"(Assented to 1st April, 1912.)

"His Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:—

"1. This Act may be cited as The Railway Belt Water Act.

"2. In this Act, unless the context otherwise requires,—

"(*a*) 'domestic purposes' means and includes household, sanitary and fire-protection purposes and the purpose of watering live stock;

"(*b*) 'watercourse' includes all natural watercourses or sources of water supply, whether usually containing water or not, and all streams, rivers, lakes, creeks, springs, ravines and gulches, and all water-power;

"(*c*) 'Railway Belt' means the land on the mainland of British Columbia granted to the Crown in the right of Canada by chapter 14 of the statutes of British Columbia of 1884 for the purpose of constructing and to aid in the construction of the Canadian Pacific railway;

"(*d*) 'riparian proprietor' means a person lawfully occupying lands adjoining and bordering upon any watercourse within the Railway Belt.

"3. The property in and the right to the use of all the water at any time in any watercourse within the Railway Belt shall, for all purposes, be deemed to be vested in the Crown, unless and until and except only so far as some right therein or in the use thereof inconsistent with the right of the Crown, and which is not a public right or a right common to the public, is established: Provided, however, that nothing in this Act shall be construed to affect any riparian right or rights to water in, on or appurtenant to those lands in the Railway Belt not granted by the Crown in the right of British Columbia to the Crown in the right of Canada or to affect any riparian right or rights to water in, on or appurtenant to lands which having been heretofore granted by the Crown in the right of Canada are not now vested in the Crown: Provided further that nothing in this section shall affect or alter the rights of any person in any action or proceeding now pending in any Court.

"4. No grant hereafter made by the Crown of lands in the Railway Belt, or of any interest therein, shall vest in the grantee any exclusive or other right, or privilege in, to or in respect of any watercourse, or in, to or in respect of the bed or shores of any watercourses, saving only the right of every grantee to appropriate in the ordinary manner so much of the water as to which he is a riparian proprietor as is reasonably necessary for his domestic purposes.

"5. The water so vested in and reserved to the Crown as aforesaid shall, during the pleasure of the Governor in Council, be administered under and in accordance with the provisions of the 'Water Act, 1909,' of British Columbia, as if the said Act was enacted by the Parliament of Canada, and the officers and authorities having powers and duties to exercise and perform under the provisions of the said Act shall have the like power and authority with respect to or in connection with the administration of the said water.

"6. The Governor in Council may direct that any Act, or portion thereof, hereafter passed by the legislature of the province of British Columbia relating to the water belonging to the Crown in the right of the province of British Columbia shall apply to the water vested in and reserved to the Crown under the provisions of this Act, as if such Act were enacted by the Parliament of Canada.

"(2) Every Order in Council passed under the authority of this section shall have force and effect only after it has been published for four consecutive weeks in *The Canada Gazette*, and every such Order in Council shall be laid before both Houses of Parliament within the first fifteen days of the session next after the date thereof, and such Order in Council shall remain in force until the day immediately succeeding the day of prorogation of that session of Parliament, and no longer, unless during that session it is approved by resolution of both Houses of Parliament.

"7. The Governor in Council may, at any time, repeal the provisions of section 5 of this Act, by proclamation to be published in *The Canada Gazette*, and upon the repeal of the said section, the water shall be administered under regulations to be made by the Governor in Council.

"8. This Act shall not come into force until a day to be named by proclamation of the Governor in Council, and such proclamation may issue when and as soon as it is agreed on the part of the Government of British Columbia that the water subject to the provisions of the 'Water Act, 1909,' of British Columbia shall be administered in accordance with the provisions of section 5 of this Act, and that the Government of British Columbia pay (but subject to such terms and conditions as the Governor in Council may prescribe for the protection of existing rights and interests) to the Receiver General of Canada the revenue derived from such administration, less the cost incurred by the said Government in connection therewith.

"9. Nothing in this Act shall be construed as conferring any interest in or authority or control over any lands belonging to the Crown in the right of Canada."

The object of this Act was: To transfer to provincial control the administration of all unrecorded waters in the Railway Belt, which waters has been declared by the Courts to be under the jurisdiction of the Dominion; the Act first affirmed that the ownership of all unrecorded waters was vested in the Crown, then proceeded to transfer the administration of such waters to the province under the British Columbia Water Act of 1909, during the pleasure of the Governor in Council.

Unfortunately, due to certain restrictive clauses and certain important omissions, the Railway Belt Water Act proved to be ineffective, and it was found necessary to amend it.

The Railway Belt Water Act, 1913, was accordingly passed, which is as follows:—

"3 GEORGE V, CHAP. 45.

"*An Act to amend the Railway Belt Water Act.*

"(Assented to 6th June, 1913.)

"His Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:—

"1. This Act may be cited as The Railway Belt Water Act, 1913.

"Paragraph (*c*) of section 2 of chapter 47 of the statutes of 1912, is repealed and the following is substituted therefor:—

"'(*c*) 'Railway Belt' means the lands on the mainland of British Columbia granted to the Crown in the right of Canada by chapter 14 of the statutes of British Columbia of 1884 for the purpose of constructing and to aid in the construction of the Canadian Pacific railway, excepting thereout and therefrom all reserves or areas that are or may be set apart and designated as Dominion Parks.

"3. Section 2 of the said chapter 47 is further amended by adding thereto the following paragraphs:—

"'(*e*) 'Minister' means the Minister of the Interior of Canada;

"'(*f*) 'Water Act' means and includes the 'Water Act' of British Columbia, the Acts in amendment thereof passed before the third day of March, nineteen hundred and thirteen, and any Act passed by the legislature of the province of British Columbia which, under the provisions of section 6 of this Act, is made to apply to the water in the Railway Belt;

"'(g) 'Board' means the tribunal constituted under the 'Water Acts,' and therein described as the 'Board of Investigation.'

'4. Sections 3, 4, 5 and 6 of the said chapter 47 are repealed and the following sections are substituted therefor:—

"'3. The property in and the right to the use of all the water at any time in any watercourse within the Railway Belt shall, for all purposes, be deemed to be vested in the Crown, unless and until and except only so far as some private right therein or in the use thereof inconsistent with the right of the Crown has been or may be lawfully established, and except that nothing in this section shall affect or alter the rights of any person in any action or proceeding now pending in any court.

"'4. No grant hereafter made by the Crown of lands in the Railway Belt, or of any interest therein, shall vest in the grantee any exclusive or other right, title or privilege in, to or in respect of any watercourse, or in, to or in respect of the bed or shore of any watercourse, unless and except in so far as any right, title or privilege to the bed or shores of any watercourse is expressly set out and described in such grant, saving the right of every riparian proprietor to the use of water for domestic purposes.

"'5. All records, grants, licenses, Orders in Council, or contracts of, for or affecting the use of water within the Railway Belt, heretofore granted or made by or on behalf of the Government of Canada or the Minister, shall, notwithstanding anything in this Act, be and be deemed to be valid and effective and shall be given effect to.

"'(2) Subject to the property in and the rights to the use of water referred to in subsections hereof,—

"'(a) all water without distinction within the Railway Belt shall, during the pleasure of the Governor in Council, for the purpose of administration be under the exclusive control of the authorities of the Province of British Columbia and be administered under and in accordance with the Water Acts as if the said Acts were enacted by the Parliament of Canada, and the officers and authorities having powers and duties to exercise and perform under the provisions of the Water Acts shall have the like powers and authority with respect to or in connection with the administration of the said water, and

''(b) all records, grants, licenses, Orders in Council, claims or contracts of, for or affecting the use of water within the Railway Belt heretofore granted, or purporting or *bona fide* claimed to have been granted, by any provincial or local authority and all applications to any such authority for records, grants, licenses, Orders in Council, claims or contracts of, for or effecting the use of water within the Railway Belt heretofore made and now pending shall be deemed to be valid and effective to the same extent for the like purposes, and subject in the like manner to the jurisdiction of the Board, (and shall be subject to all the obligations and limitations imposed by the Water Acts), as if made, issued, authorized, claimed or pending with respect to water in British Columbia not within the Railway Belt.

"'(3) All applications or claims for the use of water within the Railway Belt heretofore made to the Government of Canada or the Minister, and now pending, shall be deemed to be valid and effective and shall be subject to the jurisdiction of the Board and given effect to under the provisions of the Water Acts to the same extent and for the like purposes as if such applications or claims had been made or were pending by, to or before the competent provincial or local authority under the provisions of the Water Acts with respect to water in British Columbia not within the Railway Belt.

"'(4) All waters for irrigation allotted to Indians or Indian Reserves, whether allotted by the Indian Reserve Commissioners or recorded in Dominion

or Provincial Government offices, and all applications to any provincial or local authority for the use of water within the Railway Belt in the interest of Indians or Indian Reserves, shall be deemed to be valid and effective and subject to the jurisdiction of the Board and given effect to under the provisions of the Water Acts as if made, issued, authorized or pending by, to or before the competent provincial or local authority under the provisions of the Water Acts with respect to water in British Columbia not within the Railway Belt.

"'6. The Governor in Council may direct that any Act, or portion thereof, passed by the legislature of the province of British Columbia after the third day of March, nineteen hundred and thirteen, relating to water in the province not within the Railway Belt shall apply to the water in the Railway Belt as if such Act were enacted by the Parliament of Canada.

"'(2) Every Order in Council passed under the authority of this section shall have force and effect only after it has been published for four consecutive weeks in *The Canada Gazette*. Every such Order in Council shall be laid before both Houses of Parliament within the first fifteen days of the session next after the date thereof, and such Order in Council shall remain in force until the day immediately succeeding the prorogation of that session of Parliament, and no longer, unless during that session it is approved by resolution of both Houses of Parliament.

"5. Section 8 of the said chapter 47 is amended by striking out the words 'Water Act, 1909, of British Columbia' in the fifth and sixth lines thereof and substituting therefor the words 'Water Acts.'

"6. Section 9 of the said chapter 47 is amended by adding thereto the following: Provided that any order, permit, license or certificate made under the authority of the Water Acts authorizing the construction and maintenance of any works upon or the use or occupation of any such lands shall be valid and effective to authorize such construction, maintenance, use or occupation if approved by the Minister, and subject to such terms and conditions as the Minister may prescribe, and any such order, permit, license or certificate shall be of no effect, until so approved; Provided also that any order, permit, license or certificate made under the authority of the Water Acts authorizing the construction and maintenance of any works upon or the use or occupation of any Indian reserves or Indian lands shall be valid and effective to authorize such construction, maintenance, use or occupation if approved by the Superintendent General of Indian Affairs and subject to such terms and conditions as the said Superintendent General may prescribe, and any such order, permit, license or certificate shall be of no effect until so approved; provided also that nothing in this Act shall be construed as limiting or preventing the reclamation, under the authority of the Minister, of any lands."

THE RAILWAY BELT HYDROGRAPHIC SURVEY

The Railway Belt Hydrographic Survey was inaugurated in May, 1911, under the direction of Mr. J. B. Challies, C.E., then hydraulic engineer of the Railway Lands Branch, and now Superintendent of the Water Power Branch. Mr. P. A. Carson, B.A., D.L.S., was appointed chief engineer and placed in direct charge of the survey in British Columbia.

The objects of the survey were: (1) To investigate the complex water rights situation on the ground; (2) to suggest a practicable and efficient form of Dominion water administration; (3) to study the water supply of all streams and the water resources of the Railway Belt; (4) to investigate storage possibilities with a view to conserving and beneficially using the limited water supply; (5) to make the surveys

necessary to the proper conservation and use of the said water resources; and (6) to report on the various irrigation, reclamation and water-power projects before the Department.

On account of the scarcity of water in the 'Dry Belt,' and its extensive use for irrigation, the water rights tangle was in its most acute and complicated form in the arid district. Consequently, during the season of 1911, the investigations and studies of the hydrographic survey were devoted almost entirely to the Dry Belt.

Water records giving to individuals the right to divert and use water were granted in British Columbia as far back as 1860. These records were doubtless recorded by the applicant, and granted by the Government honestly and in good faith, but it is evident that the Government could not have anticipated the terrible confusion and endless trouble that followed from the irregular methods of administration. The older records, indeed even up to 1897, were merely made out in long hand in blank registers at the different Government offices, the applicant asking for and receiving without question the right to use any quantity of water from 100 to 1,000 miner's inches without any consideration of his real needs or a knowledge as to whether the stream could supply the quantity of water called for by the record. No track was kept of the various grants from the same source, and many streams were recorded ten times beyond their available supply. In many cases, the record holder did not receive a copy of his record, and the present owners of the appurtenant land have great difficulty in establishing their claim to the use of the water. In some records the quantity of water is not mentioned; or the purpose is not specified; or the appurtenant land is not mentioned or described; or, sometimes, the source of supply is either unnamed or it is almost impossible to identify or locate it.

There were no regular offices for the purpose of recording these water rights, but each land office performed the duties in its own inimitable manner. No system of numbering or registering by districts was attempted, and the water records from any particular stream in the Dry Belt may be scattered in the old books of any of the following offices: Yale, Lytton, Nicola, Ashcroft, Clinton, or Kamloops.

The whole province of British Columbia was in the same state up to the decision of the courts in the Burrard Power Company case, but at least the new British Columbia Water Act of 1909, gave promise of better days. With that decision, however, the water rights situation in the Railway Belt gave rise to alarming complications. Previously, the holders of water records were, or thought they were, protected by law, whereas afterward, the legal status of most records was in doubt.

Unfortunately the situation was aggravated by the extreme dryness of the years 1910 and 1911. When once the news was spread broadcast that the water records had no longer a legal standing, everyone commenced looking out for himself, and water grabbing became the order of the day. The rivalry of water users is proverbial even under the best administrated laws. The very origin of the word "rivals" indicates the tendency of man to dispute over questions of water, its derivation being from the Latin "rivus" (a river or ditch) and "rivals" signifies those who quarrel about water. So it can be imagined what the situation in the Railway Belt became when there were not even laws to protect rights.

During the summer of 1911, the engineers of the Hydrographic Survey came in close touch with the various phases of the situation on the ground, and it was soon comprehended how unenviable was the legacy that the courts had decreed was a Dominion trust. The stumbling blocks to a Dominion administration were many, the principal one being the lack of Dominion jurisdiction over water records granted before the Railway Belt came into existence. Water grants are not like land grants, each separate and distinct in itself. Each grant of water is dependent upon all prior grants from the same source of supply; and the early provincial records, over which the Dominion had no jurisdiction, practically controlled the whole situation, and pre-

cluded the possibility of a satisfactory Dominion administration independent of provincial co-operation.

Moreover, even new water records could not be granted until the indefinite status of all the early rights were adjudicated, established and defined; for new rights would necessarily be subordinate to earlier rights, and no matter how accurately the new rights might be defined as they were granted, they would remain indefinite so long as prior rights remained indefinite. Adjudication of old rights was necessarily the first step, and unfortunately the Dominion had no authority to make the adjudication.

The following enumeration of the various kinds of water rights in the Railway Belt will give some idea of the complexity of the situation: Water records granted by th province before the Railway Belt existed; water records granted by the province after the formation of the Belt, but appurtenant to old provincial lands; water records granted by the province after the Belt was formed, and appurtenant to lands which had escheated from the Dominion to the province; water records granted by the province appurtenant to unpatented Dominion lands; water records granted by the province for Indian Reserves; water records granted for Indian Reserves by the Indian Reserve Commissioners; rights to the use of or affecting the use of water, granted by the Dominion Government; incompleted water-power projects under contract with the Dominion, to which water rights were clearly incidental; rights to the use of water by Dominion timber concessionaries; indefinite and unestablished riparian rights of riparian proprietors.

There were, in addition, other phases that complicated the authority of both Governments. Streams that have their source in the province and flow into the Belt, and vice versa, could not be dealt with by one Government without affecting the rights and interests of the other. Water rights could not be administered independently of the land, for power rights demand land for power sites and storage reservoirs, and irrigation rights require rights of way for canals and land for reservoir purposes.

Owing to the impracticability of a purely Dominion administration of water in the Railway Belt, it was decided to transfer the administrative control thereof to the province, during the pleasure of the Governor in Council. This part of the question has already been discussed herein.

INAUGURATION AND INVESTIGATIONS.

"In all investigations of water resources the most important factor is the available water supply. Not only is this the most important factor, but is also the factor that requires the longest time to determine satisfactorily, owing to the great fluctuation in stream flow from year to year. In a study of the water resources of a country or district, the logical order of the investigation is: (1) stream gauging to determine the amount of water available, under existing conditions, for domestic and municipal water supply, irrigation, water-power, navigation, sewage disposal, etc., and the amount to be taken care of in flood prevention work and drainage; (2) river surveys to determine the fall available for correcting flood conditions, improving drainage, and developing water-power; (3) storage studies for the purpose of equalizing the flow, thereby reducing the floods, conserving the surplus, and increasing the low-water flow, in the interest of the above-mentioned subjects. The study of the available water supply must evidently be attempted first, for we must have a thorough knowledge of present conditions before we try to improve those conditions.

"As records of stream flow to be of value must extend over a series of years in order to determine the range of stage, that subject must be taken up first."

(Quoted from a report by Robert Follansbee, District Engineer of the United States Hydrographic Survey.)

In organizing the Railway Belt Hydrographic Survey, with its many objects and undertakings, it was decided to study the water resources in a comprehensive manner, and with the most modern methods. Accordingly, for the purely hydrographic work the methods of the United States Hydrographic Survey were adopted almost to the minutest detail. Personal knowledge was obtained of the field methods in several of the western districts and of the office methods at Washington, and too much cannot be said of the kindness and courtesy of the officials and engineers of the United States service in this regard.

It is not proposed to enter here into a discussion of the theory and methods of the Hydrographic Survey. They can be found exhaustively in the many Water Supply Papers of the United States Geological Survey.

In order that the greatest efficiency should be attained, and early mistakes avoided, one of the expert hydrographers of the United States Survey, Mr. C. R. Adams, was borrowed from Washington for a period of three months. Under Mr. Adams' direction a number of gauging stations were established on the principal and contentious streams of the Dry Belt. Discharge measurements were taken; systematic gaugings were commenced; the hydrographers were instructed according to the most approved methods; and the whole work commenced in smooth working order.

STAFF.

During 1911 the staff of the Hydrographic Survey was as follows:—

P. A. Carson, B.A., D.L.S.—Chief Engineer.
W. M. Carlyle, B.A. Sc,—Assistant Engineer. (Resigned February 17, 1912.)
C. G. Cline, B.A.Sc., D.L.S.—Assistant Engineer.
C. E. Richardson, B.A.Sc.—Assistant Engineer.
K. H. Smith, B.A.—Assistant Engineer (from September 13, 1911, to January 26, 1912).
A. T. Milner—Clerical Assistant (transferred January 29, 1912).

During 1912, the staff was:—

P. A. Carson, B.A., D.L.S.—Chief Engineer.
C. G. Cline, B.A.Sc., D.L.S.—Assistant Engineer.
E. M. Dann, D.L.S.—Assistant Engineer.
H. J. E. Keys, B.A.—Assistant Engineer (from April 1, 1912.)
C. E. Richardson, B.A.Sc.—Assistant Engineer.
Miss Allan.—Stenographer.
Mr. B. Corbould—Assistant Engineer (For June, July and August).
Mr. H. C. Hughes—Assistant Engineer (for June, July and August.)

During June, July and August, of 1911, Messrs. Carlyle, Cline and Richardson investigated water rights in the dry portion of the Railway Belt, tracing old records and making lists thereof; reporting on water supply in each locality, and whether the water was being beneficially used; inspecting ditches, flumes, storage dams and reservoirs; making a rough survey of the acreage of irrigable and cultivated land appurtenant to the records; these assistant engineers also established gauging stations and made numerous measurements of stream flow.

During September and October, Mr. Richardson extended the hydrographic work as far east as Revelstoke and Golden (district No. 3 and part of No. 4), establishing gauges and making meterings.

In October, Messrs. Cline and Smith extended the work into the Coast district

(No. 1) and investigated a number of important developed and undeveloped power streams, establishing gauging stations where advisable.

The chief engineer superintendended the general hydrographic work and, as well, inspected and reported upon all irrigation, reclamation and water-power projects, and all matters relating to water and water rights.

During 1912, the Hydrographic Survey work was continued with renewed vigour, particularly with reference to stream measurement.

Mr. Cline was in charge of district No. 1 (Coast district), Messrs. Dann and Keys attended to district No. 2 (Dry Belt) with the assistance of Mr. Corbould, a temporary assistant during the summer months of June, July and August. Mr. Richardson had charge of district No. 3 and 4, assisted by Mr. Hughes in district No. 4 during June, July and August.

SCOPE OF INVESTIGATIONS.

The investigations herein published are by no means complete, nor do they cover and include all the streams and sources of water supply in the Railway Belt. The scope of the work done, and the territory covered, was limited by the available funds, the staff of engineers and hydrographers, and the time at our disposal. Rome was not built in a day, and a comprehensive hydrographic survey cannot be fully established even in a couple of years. The field covered has been partly governed by the exigencies of the Railway Belt water rights situation, which demanded our more concentrated energies in the irrigation district of the 'Dry Belt,' although the work has since been extended over almost the whole Railway Belt, until we feel that the territory covered is the largest and the class of work done is the best under the circumstances.

Before the inauguration of the Hydrographic Survey, there were practically no data of stream flow in the Belt, except certain studies by large irrigation and water-power companies, such as the British Columbia Fruitlands, the Vancouver Power Company and the Western Canada Power Company. There were, it is true, certain isolated and sporadic data obtained by private individuals and engineers which conveyed some information, but this is of little value to systematic and co-related studies.

In establishing a permanent Hydrographic Survey, it was deemed advisable to lay the foundations broad and deep, by commencing the study of as many representative streams as possible, particularly establishing gauging stations on most streams of known importance or of a contentious nature. Gauge readings first, measurements of stream flow next, then storage and conservation investigations, with necessary surveys, all with the object of the most beneficial use of the available supply for all purposes. The work might have had more immediate scientific value if our endeavours had been concentrated on a few typical drainage areas, but we are firmly of opinion that in the long run our more comprehensive programme is the better one, from both practical and scientific standpoints.

While it is believed that the stream flow data already obtained are of themselves sufficiently accurate for ordinary practical purposes, the records do not cover a long enough period to warrant reliance on any general deductions drawn therefrom. It is essential that records of stream flow should be kept during a period of years long enough to determine within reasonable limits the entire range of flow from the absolute maximum to the absolute minimum. The length of such a period manifestly differs for different streams. Experience of the United States Hydrographic Service has shown that the records for some streams should cover five to ten years, and those for other streams twenty years or even more, the limit being determined by the relative importance of the stream and the interdependence of the results with other long-time records on adjacent streams.

All persons are cautioned from placing too great reliance on the incomplete records here published, and from drawing general deductions from the specific data of two particular years. In spite of our own admonition, however, we are willing to assist engineers and the public in drawing rough estimates regarding stream flow, based on the results of our two seasons' investigations, our knowledge of these and previous years, evidence of high-water marks, precipitation, etc., and the recollections of old timers.

In the Dry Belt, the years 1910 and 1911 saw the culmination of a dry cycle which had been tending since the last flood year, 1903. The year 1912 was one of more than average run-off in the easterly part of the Dry Belt, but by no means a maximum year. Near Spence's Bridge and Lytton the run-off in 1912 was below the average. The winter of 1911-12 set in early in November with a very cold snap. After the ground had frozen the snow came. There were no very warm Chinooks during the winter, and the April and May sun caused a rush of the flood water in the surface streams, very little water percolating into the soil either as subsurface flow, or to elevate the level of the water table. During the summer some heavy rains occurred in the Dry Belt which kept up the flow of the surface streams fairly well even in July and part of August. There was very little water scarcity during 1912 and, on account of the summer rains, a smaller quantity of irrigation water was really used.

In the Coast district the year 1912 was about an average year.

In Revelstoke and Upper Columbia districts the total run-off was below normal. In all the large rivers, Columbia, Thompson, and Fraser, the maximum for the year was greatly below the years 1894 and 1903.

HYDROGRAPHIC DISTRICTS IN THE RAILWAY BELT.

The Railway Belt may be conveniently divided into four hydrographic or water districts:—

(1) Lower Fraser drainage, or Coast district.
(2) Thompson drainage, or Dry Belt.
(3) Shuswap Lake drainage.
(4) Columbia drainage.

District No. 1.—The first district, or, as it is commonly called, the Coast district, consists of the lower Fraser drainage, and extends from the Pacific coast northeasterly for about 175 miles, to above Lytton and the mouth of Thompson river. Besides the Fraser itself, it includes all its tributaries, large and small, with the exception of the Thompson, which, on account of its size and importance, has been treated as a separate drainage district. In addition to the streams that actually drain into the Fraser, there are included in district No. 1, those streams that flow into Burrard inlet and other arms of the strait of Georgia (e.g., Mesliloet river) as they are not of sufficient importance to be considered separately.

The Coast district, at its lower or westerly limit, is one of excessive humidity, the precipitation in some cases exceeding 150 inches, and on the whole ranges from sixty to seventy inches in the valleys, and from 80 to 150 inches in the higher elevations.

The climate is comparatively mild, with but little snow in the valleys. The mean snowfall in Vancouver is only about 20 inches, although early in January, 1913, some 4 feet of snow fell in that city. The rainy season generally lasts from October to March. The summers are cool with an abundance of rain in the growing season.

Proceeding inland the humidity decreases. At Hope, about 75 miles from the coast, the annual precipitation is about 30 inches, the snowfall is greater, and the

rainfall during the summer season less. The winters are also colder and the maximum summer temperature higher.

At Lytton, 150 miles from the coast, the Dry Belt or arid region has been reached. Here, at the mouth of Thompson river, the precipitation is only from 9 to 11 inches, with hot dry summers and cold dry winters. The Fraser valley above Lytton is in the Dry Belt for over a hundred miles. The main characteristics of the Dry Belt will be discussed under district No. 2.

In the lower Coast district, the plant and tree growth is very luxuriant. Enormous fir, cedar, hemlock, etc., some of the former being from 10 to 15 feet in diameter. The timber industry is of great importance. The undergrowth is of the rankest description, with ferns, nettles, devil's club and alder. No irrigation is necessary. The study of stream flow and water supply is of the greatest importance in connection with water-power. The district is a mountainous one (5,000 to 7,000 in elevation), and on all streams, large and small, there is considerable fall before the waters reach the main artery, the Fraser, which conducts them to the sea. Already two of the best powers, from an economic standpoint, have been developed, viz., the Coquitlam-Buntzen hydro-electric power development (by the Vancouver Power Company) and the Stave river by the Western Canada Power Company. These two companies supply hydro-electric power to the city of Vancouver, and the former for its urban and suburban electric tram lines.

The following industrial powers will probably be developed in the near future, or according as the progress of the Coast requires: Chehalis river, Lillooet river, Jones lake, Chilliwack river, Nahatlatch river, Coquihalla river, etc., some of them being capable of developing up to 30,000 horse-power. Most of these rivers are being investigated by private companies, and hydrographic data are being gathered, the Hydrographic Survey co-operating in the work. In addition, there are numberless small powers that can be conveniently and economically developed for private purposes or small industrial uses.

About thirty-three river stations have been established in the Coast district, determining the daily, monthly, yearly, maximum and minimum flow, etc., and investigating the storage possibilities. At the same time, the importance of stream flow in connection with domestic and municipal water supply, drainage and flood prevention has not been forgotten. The run-off of the coast streams is also of importance to the sewerage problem of the growing cities of the Burrard peninsula.

District No. 2.—This district is the lower or major part of the Thompson drainage, and is commonly called the 'Dry Belt.' It is an arid strip of territory about 100 miles in width, extending from about Lytton on the west to the town of Chase on the east, about 30 miles east of Kamloops. It comprises such well-known valleys and communities as Lytton, Spence's Bridge, Nicola valley, Ashcroft, Walhachin, Savona, Kamloops, North Thompson valley, Cherry creek, Monte creek and Grande Prairie, although the last-mentioned really belongs to district No. 3, being at the head-waters of Salmon river.

In general, district No. 2 consists of the main Thompson and its many tributaries from Lytton to Kamloops; the North Thompson within the Railway Belt; and the South Thompson from Kamloops to Chase.

The Dry Belt is made up of narrow valleys and rolling plateaus, covered mostly with scattered bull pine and small timber. On the highest mountains (elevation 5,000 feet to 6,000 feet) are also good fir and some cedar and hemlock. The soil is of the distinctively arid type, sandy soil or sandy loam, with gravelly or sandy subsoil. In some places there is an abundant growth of cactus and sage bush. These lands are very fertile when irrigated, the warm sandy soil producing a kind of hot-house growth. Fruit-growing is successfully carried on, but especially alfalfa, timothy, grain, vege-

tables (potatoes, tomatoes, onions, melons, etc.), and indeed almost all crops known to mixed farming.

The Fraser valley above Lytton and the Thompson valleys range from 700 to 1,200 feet in elevation, and are irrigated mostly by gravity supply from the numerous creeks and rivers which cut the main valleys transversely in deep gorges. The lands in the back valleys are higher in elevation, from 1,500 to 3,000 feet, and their productiveness is limited, by early frosts and the shortness of the growing season, to hay and the hardy crops and to stock raising.

The mean annual precipitation in the Dry Belt is only from 8 to 12 inches per annum in the valleys and from 10 to 15 inches in the hills. The rainfall in the summer is very small. The snowfall in the valleys is only from 12 to 24 inches, but is as great as 4 to 6 feet in the hills. The summers are extremely hot (105° F.) and dry, and the winters cold and dry (–20° to –40° F.).

The study of stream flow in the Dry Belt is of the greatest importance in connection with irrigation, particularly the numerous large and small tributaries of the Thompson, as it is from these myriad streams, more or less reliable in their supply, that all the irrigation water is obtained.

The warm sun in April and May, assisted by earlier Chinook winds, melts the snow in the hills at the head-waters of the streams, and an enormous freshet flow generally takes place between the second and third week of May. This flow quickly subsides in June. In July and August many of the streams are dry, just when water is badly needed for irrigation. The fall rains are not heavy, and they cause merely a perceptible increase in the low flow of the creeks. In the winter, the streams are almost completely bound up by the frost and snow.

The conservation of these surplus waters of the spring floods by the construction of storage works is doubtless the solution of the water scarcity in the Dry Belt, and the measure of the future agricultural potentiality of the interior of British Columbia.

Nearly every stream in the Dry Belt is being used more or less for irrigation, but only sporadic efforts have been made to properly conserve the flashy supply. The irrigation is mostly carried on by individual farmers with small private ditches, there being very little co-operation either in storage works or irrigation systems.

The small irrigation ditches are, on the whole, crudely constructed, and a great deal of water is lost in transmission. In a word, irrigation in the Dry Belt of British Columbia cannot be described as a science. On the other hand, the past few years have seen the formation of several large irrigation companies which have constructed modern and expensive storage works, with excellent main canals and distributing systems. It is anticipated that a vigorous policy of Government supervision of the use and control of water will be pursued under the present British Columbia Water Act.

Most of the important streams in the Dry Belt have been systematically studied by the Hydrographic Survey, investigating the daily, monthly and seasonal run-off, with a view to securing a complete knowledge of the water supply, and its behaviour, in order to properly advise as to its conservation and assist in the administration of its use. The numerous private storage dams and reservoirs have been inspected, together with the intakes, ditches, flumes, distributing systems and methods of applying water. The losses in transmission in many canals and ditches have been investigated and measured. Storage lakes, reservoirs, and sites of all kinds have been reconnoitred, an estimate made of their capacity, the quantity of available water for storage, and the nature, size, cost, etc., of the necessary storage dams and works.

On account of the system of granting water records lately in vogue, both for ordinary use and for storage, it seems improbable that co-operative construction of storage works can be obtained among the individual record holders. In the general interests of the irrigators and farmers, the Government itself, and the whole district

at large, it would seem that a policy of Government construction of storage works is the best and final solution to the conservation question. The Government assists ordinary agriculture by constructing roads, etc., by experimental farms, and grants of money. The timber industry is assisted in many ways, and recent forest laws show a tendency to Government conservation of timber, its reforestration and fire protection. Similar remarks can be made of mining and fishing. But what has ever been done for that natural resource, water, the value of which can be well contrasted with any of those previously mentioned? Some day, unless the rights granted under the present water laws preclude the possibility, the Government should undertake the construction of extensive storage works in order to conserve the valuable resource, the ownership and use of which has been declared to be vested in the Crown as a public asset.

Although the exigencies of irrigation in the "Dry Belt" demanded first consideration, the requirements of domestic and municipal water supply have also been remembered. There are also a number of streams where power could be developed, although on account of the small winter flow it is doubtful if they could be used as other than summer powers, except on a small scale. These are Spius creek, Murray creek, Stein creek, Bonaparte river, Deadman river, Paul creek and Louis creek.

About 69 streams in the Dry Belt were systematically studied during 1911 and 1912 and, on 30 others, miscellaneous measurements were made.

The run-off of the irrigation streams in the Dry Belt was very small in 1911, which was an abnormally dry year. In 1912, the run-off was about normal in the greater portion of the Belt, except towards Spence's Bridge and Lytton, where it was again small. During the summer of 1912 some very heavy rains occurred which decreased the quantity of water necessary for irrigation.

District No. 3, or Shuswap Lake drainage, extends from the outlet of Shuswap lake, near the easterly limit of the Dry Belt, to the summit of the Gold range, near Eagle pass, and includes the area draining into Shuswap lake. This district is in reality part of the Thompson drainage, but for convenience is considered as a separate district. It comprises such streams as Adams river, Salmon river, Shuswap river, Eagle river, Anstey river and Seymour river. The precipitation ranges from 12 to 15 inches near the head of Salmon river (in Grande Prairie) which is in the Dry Belt, to about 40 to 50 inches at the summit of the Gold range. Around Salmon Arm and the northerly part of Okanagan valley (near Armstrong and Enderby), the climate is semi-arid, with a precipitation of from 15 to 21 inches, but the amount in the growing season is sufficient to render irrigation unnecessary. There are no evidences of aridity, such as bull pine, sage bush or cactus. Fruit-growing is successfully carried on, and all kinds of mixed farming, but in the greater portion of the district there is little agricultural development, the land being rolling and rather hard to clear. There is excellent timber in nearly all the valleys and on the mountain sides.

Shuswap lake is at an elevation of 1,154 feet (high water), and the surrounding mountains rise to an elevation of 6,500 feet. At the summit of Gold range they are between 7,000 and 8,000 feet.

Just at the easterly limit of the Dry Belt is one of the most important undeveloped water-powers in the interior of British Columbia. Adams river falls about 190 feet in six miles and is only a few miles from the main line of the Canadian Pacific Railway. The river has a mean discharge of about 2,500 cubic feet per second, and Adams lake, with an area of 60 square miles, affords an excellent storage reservoir. Hydro-electric power from Adams river should be of great importance to the agricultural development of the South Thompson valley, for by this power water could be cheaply pumped to irrigate the arid valley lands lying adjacent to the Thompson.

About thirteen hydrographic stations were established in district No. 3. It is planned shortly to make a reconnaissance of the streams flowing into Shuswap lake from the north, as this part of the district has not yet been investigated.

District No. 4, or the Columbia drainage, extends from the easterly slope of the Gold range to the summit of the main Rockies, which is the easterly boundary of British Columbia and the Railway Belt, incluling the snowy Selkirks.

The greater part of the Columbia drainage lies outside the Railway Belt, so we are mainly concerned with that portion above and below Revelstoke and the upper Columbia from Beavermouth and Golden to lake Windermere.

For an exhaustive discussion on Columbia river, see the river stations on that stream.

Around Revelstoke the climate is humid (40 to 45 inches) with short, hot summers, cool evenings and very severe winters, with heavy snowfall. Owing to the heavy timber, the land is difficult to clear, and the agricultural development has been slow. There is excellent timber in the whole district, which is being extensively logged and sawn at the mills. Some mining is also done.

The elevation of Columbia river at Revelstoke is 1,450 feet. The mountains rise to an elevation of 8,000 and 9,000 feet, and at the summit of the Selkirks, up to 10,000 and 11,000 feet.

There are a number of good undeveloped water-powers around Revelstoke, viz., Illecillewaet river, Akolkolex river, Jordan river, and Incomapplaux river, as well as the Columbia itself, five miles above the town of Revelstoke. A power plant has already been installed on Illecillewaet river by the town of Revelstoke for lighting and power purposes.

There are practically no interests on Columbia river from Golden to the north limit of the Railway Belt, except timber. Power could be developed on Blaeberry river and possibly on Beaver river. The valley is at an elevation of over 2,000 feet, and the mountains rise to an altitude of 9,000 to 10,000 feet. The precipitation ranges from 40 to 70 inches, and the snowfall is heavy, with a cold, severe winter.

The only important tributary of Columbia river from the direction of the main Rockies is Kicking Horse river, important interests of which are discussed under that stream.

The upper Columbia valley from Golden to Windermere is an arid district, the moisture-laden winds from the west simply passing over the valley, leaving it almost devoid of precipitation (about 17 to 21 inches around Golden, and from 8 to 12 inches near lake Windermere). For a complete description of the upper Columbia valley, see "Columbia river" hereinafter.

About twenty-three river stations have been established in district No. 4, beside numerous miscellaneous measurements on more or less important creeks.

WATER AND STREAM FLOW.

"There is no single substance entering into the structure of the earth which has played and is playing so important a part as water. It penetrates the soils, sands, and rocks of the land areas in such large quantities that sand and limestones lying below water level may contain as high as 38 per cent of their volume of water. Even the quantity stored in soil, gravel and clay is very large. The water in a saturated soil or clay may range from 22 per cent up to 40 and even 50 per cent of its dry weight."—(Professor F. H. King.)

"Water has the greatest direct influence upon man, his health and industries. Its quality, and especially its quantity, directly affect his occupations. If there is too much, the ground is marshy, malarial, and unfit for cultivation; if too little, the plants valuable for food do not thrive. There is a narrow range between excess and deficiency, and upon the nice adjustment of the balance between moisture and drought depends the existence of prosperous communities."—(Newell.)

"The waters of the earth are taken up by the process which we call evaporation and formed into clouds, to be again precipitated to earth in the form of rain or snow. Of the water which falls upon the basin of a stream, a portion is evaporated directly by the sun; another large portion is taken up by plant growth and mostly transpired in vapour; still another portion, large in winter but very small in summer, finds its way over the surface directly into the stream, forming surface or flood flows; finally, another part sinks into the ground, to replenish the great reservoir from which plants are fed and stream flow maintained during the periods of slight rainfall, for the rainfall is frequently, for months together, much less than the combined demands of evaporation, plant growth, and stream flow. These demands are inexorable, and it is the ground storage which is called upon to supply them when rain fails to come.—(Vermeule.)

"All of these ways of disposing of the rain which falls upon the earth may be classed as either evaporation or stream flow. Evaporation we make to include direct evaporation from the surface of the earth, or from water surfaces, and also the water taken up by vegetation, most of which is transpired as vapour, but a portion of which is taken permanently into the organisms of the plants. Stream flow includes the water which passes directly over the surface to the stream and also that which is temporarily absorbed by the earth to be slowly discharged into the streams. A portion, usually extremely small, passes downward into the earth and appears neither as evaporation nor as stream flow. It is usually too small to be considered, and we may for our purposes assume that all the rain which falls upon a given watershed and does not go off as stream flow is evaporated, using the latter word in the broadened sense which we have above described."—(Vermeule.)

Important as the underground waters may be, we are at present more particularly interested and concerned in the surface water of our country, that valuable natural resource, the tremendous importance of which has only recently been recognized by our Governments: water for domestic and municipal use, water for irrigation, water-power (the cheap white coal of modern industry), mining, logging, and navigation.

Within the last few years Governments have come forward and declared that water is a public resource vested in the Crown, and shall be used for the common good.

Having taken possession of this great resource, it behooves the Governments to administer it wisely and well. It is axiomatic that to do this, one of the first things is to take stock; see how much there is; where and how it is distributed; and how it can be most beneficially used and conserved.

The methods of the United States Hydrographic Survey are undoubtedly the most modern and approved for measuring and determining the quantity of water flowing in a stream from the largest river to the smallest ditch at any instant, during any day, month or year, whether in terms of the unit of flow (second-feet) or the unit of quantity (cubic feet or acre-feet).

It is not the intention to discuss these methods in this report, but merely to outline how they were made to apply to the hydrographic survey work in the Railway Belt and the peculiar conditions encountered in that district.

METHODS OF MEASURING STREAM FLOW.

(1) By the slope method (with Kutter's or Chezy's formula).
(2) By weirs.
(3) Area and velocity method.
  (*a*) Float measurement of velocity.
  (*b*) Current meter measurement of velocity.

(1) The slope measurement was rarely used by the Hydrographic Survey, and then only as a check on current meter measurements of large streams at the extreme flood period, when the velocity was very high.

(2) The weir method may be used conveniently for measuring the flow in small irrigation ditches and flumes. For the flashy mountain streams of British Columbia, it is unsatisfactory, as the flood flow is often twenty-five to fifty times greater than the low summer flow, and there is also danger of the weir being washed away.

The different kinds of weirs and their formulæ may be found in any text book or Engineer's manual.

In Bulletin No. 44, British Columbia Department of Agriculture, Professor Etcheverry gives an excellent discussion on weirs (especially the Cippoletti weir), and other measuring devices for use in irrigation canals and ditches. This article should be of great value to the irrigating farmer.

(3*a*) Float measurements were taken when only a rough estimate of discharge was desired. This method can be easily used by the layman who wishes to obtain an approximate idea of the flow of any river or stream.

In a small pamphlet compiled by the Commission of Conservation (A. V. White), entitled "Instructions relating to the gathering of certain preliminary information respecting water-powers" the float method is discussed and a valuable table is appended for the determination of the co-efficient to apply to the surface velocity. This co-efficient (K) ranges from ·70 to ·90, varying inversely with the surface velocity, directly with the depth of the water, inversely with the material forming the bed of the channel, and inversely with the width of the stream. This table is reprinted here.

FLOAT MEASUREMENTS.

The following table will serve as a rough guide in the determination of the most probable co-efficient (K). Interpolate for conditions not given in the table.

Velocity. (Feet per Second).	Average Depth. (Feet).	Size of Material on Bottom. (Feet).	Co-efficient. (K.)
2 or less	2 or less	½ or less	·80 to ·85.
2 "	2 "	1	·75 to ·80.
5	2 "	½	·80.
5	2 "	1	·75.
10 or more	2 "	½	·75.
10 or more	2 "	1	·70.
2 or less	5	½ or less	·85 to ·90.
2 "	5	1	·85.
2 "	5	3 or more	·85.
5	5	½ or less	·85.
5	5	1	·85.
5	5	3 or more	·80 to ·85.
10 or more	5	½ or less	·80 to ·85.
10 "	5	1	·80.
10 "	5	3 or more	·80.
2 or less	15	½	·90.
2 "	15	1	·90.
2 "	15	3 or more	·90.
5	15	½	·90.
5	15	1	·90.
5	15	3 or more	·85 to ·90.
10 or more	15	½	·90.
10 "	15	1	·85 to ·90.
10 "	15	3 or more	·85 to ·90.

The co-efficient close to abutments or piers usually lies between 0·9 and unity, and is sometimes greater than unity.

CURRENT METER MEASUREMENTS.

(37) Nearly all the measurements of stream flow were made by means of a current meter. The instrument universally adopted by the Railway Belt Hydrographic Survey is the small Price electric meter, made by Gurley & Co., and called "No. 621" in their catalogue. This meter registers either every revolution or every fifth revolution (single head or penta head) by means of an electric contact, the sound being transmitted to the observer by means of telephonic attachment. In most of the British Columbia streams the velocity is fairly fast, and the penta head commutator was used. A two-story carrying box was used for carrying the meter and accessories. This box is the design of the United States Hydrographic Survey and can be secured from the Gurley Co.

The meter may be attached to wading rods for taking measurements in shallow streams. Or it may be attached to a cable and suspended in the water by torpedo-shaped weights, while the hydrographer measures from a boat, a cable and car, or from a bridge.

Instead of the heavy double-insulated cable supplied by Gurley for suspending the meter in the water, the Railway Belt Hydrographic Survey manufactured a suspension cable of its own. This is a one-eighth-inch mild steel cable from which the manila core was removed and an insulated (magnet) wire inserted in its place. This gave the return circuit in a single wire, which has tremendous advantages over the old form of cable. It is of such small diameter that it offers less resistance to the current, and the meter is not carried so far downstream. This gives better soundings and truer depths at which the observations are taken. Morever, less lead weights need be used, which makes the work easier for the hydrographer. It is advisable to cover the upper part of the cable with friction tape to give a better grip of the hands and also to prevent kindling.*

The great advantage of the small Price electric meter (No. 621) is that it can be used to measure a stream of any size, from the smallest ditch to the largest and swiftest river.

In general, measurements were made by the two point method (·2 and ·8), and sometimes by the three point. In very shallow streams, the ·6 depth alone was used. In the flood discharge of some large, swift rivers it was almost impossible to submerge the meter to the proper depth even by the use of a stay line. In such cases, surface measurements were made with the meter and the proper co-efficient applied.

Generally at a measurement sufficient observations were taken to total sixteen in the section. In very wide rivers many more were often taken..

It would be superfluous to enter here into a full description of the current meter, its use, and care, but the following little points were specially noticed by the hydrographers in the Railway Belt, and are given as a guide to inexperienced users of the small Price electric meter. Keep bearing point and parts oiled and clean to prevent rusting. Keep bearing point nicely adjusted. Keep lock nut of bearing point tightened. Keep all set-screws tight, particularly those controlling bearing point sleeve, and vanes. Keep platinum contact spring in commutator in adjustment so as to make a sharp contact but not to bear too heavily. Before each measurement, and frequently during a long measurement, test the meter head by spinning it in the air to see that it runs freely. A meter in good adjustment should run at least sixty seconds freely in the air. Test dry cell battery before each trip, and if it is getting weak, take a fresh one along. Always carry a spare bearing point, a spare platinum contact spring, and several set-screws.

* The single wire suspension of the electric current has been tested by the Railway Belt Hydrographic Survey, but has not yet been used in actual practice. The meter is suspended by a single wire or cable, and from the observer another wire is connected with the water which completes the circuit to the head of the meter.

RATING OF METERS.

Each meter must be rated in order to determine the relation between the revolutions of the cups and the velocity of the water at the point of observation. When the small Price electric meter is new, the United States composite rating table may be used. This rating table is based on the ratings of a large number of meters of the one pattern, and, it is believed, is more nearly correct than a single rating of any one meter. After one season's use the meters were rated at the Calgary rating station by the courtesy of the Commisssioner of Irrigation. It was found that the individual ratings agreed very closely with the composite table. After the second season's service, in 1912, the meters were again rated at Calgary, and it was this time found that the meters were running with less friction than when new. Consequently, new rating tables were made for each meter.

GAUGING STATIONS.

The fundamental principle, or assumption, on which hydrographic determination of stream flow is based, is that the discharge is a function of the gauge height. Conditions being constant, the discharge is always the same for the same stage of river height; and for any stage the discharge can be determined by formula, generally a graphic one. This principle of stream flow holds approximately true so long as the conditions controlling the flow in the vicinity of the gauging station remain reasonably constant. For a complete discussion of this principle, see chapter 6, of 'River discharge' by Hoyt and Grover (1st edition).

In establishing a gauging station, the first thing to do is to carefully consider the object of the station, and what information the data, when obtained, will show. Sometimes it is desired to study the total flow of a stream at its mouth; or above or below a certain tributary; or at a proposed power site or intake; or perhaps, in connection with storage, it is desired to know the flow from or into a lake. With the object of the station in mind, a thorough reconnaissance of the vicinity should be made to obtain the best location for the gauging station. Now, a gauging station consists of two essential parts, viz., the gauge and the measuring section. Although not absolutely necessary, it is eminently desirable that the gauge and the measuring section should be at one and the same section. But a good measuring section is not always suitable for a gauge, and *vice versa*. If the two are not in the same section, an auxiliary gauge should always be placed in the measuring section, on which readings should be taken during meter measurements, and to which soundings, etc., are referred. This is necessary to determine any shifting of the bed or other changing conditions, and to project the area of the section for any stage.

A gauging station should generally be established at low water, but it has been the experience of this Hydrographic Survey that it is often more important to be familiar with the high-water conditions. This is especially so in the 'Dry Belt', where at the low stages it is almost impossible to appreciate the conditions that occur during the May freshet.

In the Railway Belt, the streams measured range from small irrigation streams that are mere trickles in the late summer and rushing torrents in the month of May, to large rivers like the Fraser, which has a maximum flood discharge of nearly 300,000 second-feet, and a velocity of 10 or 12 feet per second.

The choice of a gauging station on large rivers like the Fraser, Thompson and Columbia, depends mostly on the practicability of obtaining a satisfactory measuring section, and the cost of installing the necessary equipment for making the meter measurements. In some cases a good bridge is available, crossing at right angles

over a section with uniform current; and when it is evident that conditions are fairly constant, a station is established easily and at small cost. Meter measurements are conveniently made at a bridge station, especially after the first measurement has been taken, with soundings (projected to high-water mark); a permanent initial point well marked; metering points plainly marked along the rail of the bridge; depths referred to the bridge rail, etc. (See bridge station on Columbia river at Revelstoke, Thompson river at Spences Bridge, and Thompson river at Kamloops.)

On large streams in British Columbia the conditions are fairly constant, and the beds are not liable to shift. On the other hand, the velocity at the flood period is often so swift that it is almost impossible to sink the meter to the desired depths. In such cases it is necessary to resort to measurements of surface volocities with the meter.

Where no suitable bridge is available, measurements from a boat are often made. (See station on Fraser river at Hope.) Here the river is 1,000 feet wide, and a cable station would be very expensive if not impracticable. A motor boat is anchored at various points in the section, and its distance from the initial point determined by means of a transit and measured base on the shore. In narrower rivers, a mild steel cable is stretched across, and a boat is moored thereto. The cable is generally tagged, and the meterings thus made at desired intervals. (See station on Fraser river at Lytton.)

Where a river is too swift or rough for a boat, it is often necessary to establish a cable station. This consists of a strong cable stretched across the river at the section, and a small car suspended from the cable in which the hydrographer sits, and makes the meterings at the desired distances. Where the initial cost is justified, a cable station is most satisfactory. (See station on Nahatlatch river.)

On streams not much over 100 feet wide, and which cannot be measured conveniently by wading, by a boat, or from a bridge, the hydrographers of the Railway Belt Hydrographic Survey stretch a light endless wire cable across the stream; then they operate their meter from the shore by means of ropes and pulleys. This method can be used satisfactorily only when the meter is suspended by a small cable with insulated core, as has been described hereinbefore. (See Current Meter Measurements.)

The establishment of stations on the small irrigation streams at first seems comparatively easy, especially at low-water stages; but it is on these streams that the greatest difficulties have been encountered. The stage is very low during the later summer and winter, in fact for nearly ten months of the year. The discharge during the spring freshet in May is often fifty or a hundred times greater than the flow in July or August. Consequently, the effect of this sudden rush of a large body of water is to disturb conditions near the gauging station so that a discharge curve already established is no longer applicable. Indeed, oftentimes the gauge is washed out, the banks torn away, and the whole channel altered almost beyond recognition. In establishing stations on these flashy streams at low water, a full knowledge should be gained of the flood conditions, and a place obtained where permanent bed and banks continue from year to year.

Note should also be made of any existing diversion canals above or below the station; the existence of artificial control by storage works; the existence of side channels at any stage; the possibility of underground channels or seepage near the station.

GAUGES AND GAUGE READERS.

The word "gauge" in hydrographic work signifies a graduated scale or other instrument for recording the stage and changes in stage of the water level of a stream or lake. A gauge may be recording or non-recording. Recording gauges on account of their mechanism are rather expensive, and at present are scarcely justifiable in

ordinary stream-flow measurements. But on important streams, where the continous fluctuation of the water level is desired, or where small fluctuations are of great importance, recording gauges should be installed. There are many designs of recording gauges now on the market: Stevens, Frieze, Gurley electric, Gurley simplex, Barrett and Lawrence hydrochronograph, Bristol, Welsh, Haskell, Watson, etc. These range in price from $50 to $200, exclusive of the cost of installation. Some recording gauges need attention each week, others will run continuously for a month. The Railway Belt Hydrographic Survey has not yet installed any recording gauges, but several are used by the large power companies.

The gauge in general use in the Railway Belt work is the ordinary vertical staff gauge. Most of the gauges set were 2-inch by 4-inch scantlings, planed smooth, and painted white. Each gauge was graduated in feet and tenths in black paint, and the whole varnished. These gauges, however, were soon affected by the water and scum, and became almost illegible. A metallic staff gauge has recently been adopted. It is made of enamelled iron, one-eighth-inch thick and three and one-half inches wide. It is in sections each three feet long. Each section is graduated in tenths, one reading from zero to three feet, the next from three to six feet, and so on. The graduations and the figures are in blue on a white ground. Each graduation, including the tenths, is numbered, so as to allow no probability of the gauge reader making a mistake. The average gauge reader seems to think that the tenths of a foot are inches, and where a gauge is numbered only at the integral feet, he is liable to count back from the first number that is visible above the water surface. For example, if the gauge really registers 4·7, the gauge reader will probably note that it is three graduation divisions below the 5-feet mark, and will record the height as 4·9, meaning 4 feet, 9 inches.

The enamelled iron gauge rods are screwed to a plank backing, to a bridge pier, or other convenient and permanent location. They have a smooth surface, are easily cleaned of scum and other deposit, and are very legible. They are cheap, portable and permanent.

For large rivers with great fluctuation of stage, special board guages of the necessary length are painted in black and white.

Where vertical staff gauges could not be conveniently or satisfactorily placed, chain gauges were installed. A chain gauge is, briefly, a chain of known length with a weight at the lower end and a marker at the upper end. The chain passes over a pulley, and the weight is lowered until the lowest point of the weight just touches the surface of the water, forming a little V-shaped riffle as it comes in contact with the running water. The height of the surface is then registered either directly on the chain, if graduated, or by a graduated board on the hand rail of the bridge or other support of the gauge.

It should be noted that in all cases the zero of the gauge is placed at an arbitrary datum, and has no relation to the bottom of the stream or to zero flow. Therefore the gauge rarely registers the absolute depth of the water, but merely the height of the water surface above the arbitrary zero of the gauge. The difference between any two gauge heights represents the rise or fall of the river in the section where the gauge is located.

The gauge should always be fastened securely so that there is no danger of its being washed away by floods, ice or logs; or of shifting even a trifle in elevation. In case of destruction or shifting, permanent bench-marks should always be established and referred to the datum of the gauge. If possible, also, the elevation of the datum should be referred to some point whose elevation above the sea is known, such as railway bench-marks, etc. The datum of the gauge should be checked each season. For establishing bench-marks a small light level is sufficient, as rarely are sights of over 50 or 75 feet necessary. A gauge should be checked to the nearest one-thousandth.

The zero of the gauge should be below the lowest level of the water at its minimum stage, so that negative readings should not be necessary.

A gauge should be placed in a spot where there is no backwater from other streams just below, or from a dam, gorge or other obstruction. The banks and bed should be permanent and unshifting; the banks should not overflow at high water; and there should be but one channel at all stages.

If the gauge is not in a sheltered location, it is sometimes necessary to place a stilling-box. This prevents erroneous readings from wave-action or splashing of the current against the gauge, particularly at high water.

The gauge is generally read by a neighbouring farmer or resident, readings being taken twice a day, daily, tri-weekly or weekly accordingly as circumstances permit, and the changes of stage warrant. The gauge readers are paid on an average $5 per month, where daily readings are made and a distance of not more than ¼ mile has to be travelled.

The gauge readers are supplied with a small book in which their readings are recorded. Each book holds three months' readings, and is sent to head office at the end of each quarter. Postal cards holding a week's readings are also supplied. The gauge readers mail these weekly, and the head office and the hydrographers are thus able to keep in touch with the stage of the stream and other circumstances of the station.

On the whole, gauge readers are fairly reliable; that is, they record accurately the readings they actually make, but are sometimes inclined to interpolate readings they have omitted. This is particularly so when a gauge reader becomes adept at reading and familiar with the behaviour of his stream. Women and girl readers generally give the best satisfaction.

MEASUREMENTS OF STREAM FLOW DURING THE FROZEN SEASON.

As soon as a stream freezes, either at the gauge or between the gauge and the control, the discharge ceases to be the same function of the gauge height that it is during open conditions, and separate investigations have to be made during the frozen season.

Meterings are easily made, generally through holes in the ice at regular distances, and they are as precise as ordinary open channel measurements. Care should be taken, however, to prevent the meter from freezing, by keeping it submerged in the water except when carrying it from hole to hole.

A record of the gauge height is made at the same time, through a hole cut in the ice at the gauge, the record comprising as well the thickness of the ice, and the depth of the water below the surface of the ice. A sketch should also be made showing how the ice conditions exist over the whole channel from the gauge to the control. A similar record and sketch should be taken by the gauge reader weekly or semi-weekly, together with records of the daily temperature, and notes regarding ice conditions, anchor ice, blocking or choking of the channel, and so forth.

By taking meterings about once a month, the daily discharge can be interpolated from the records of gauge heights and temperatures with a fair degree of accuracy.

Where there is a good control below the gauge, such as a pronounced fall or rapid, and open conditions continue at the control even when the channel is wholly or partly frozen at the gauge, the open channel curve can generally be applied, with perhaps a constant correction co-efficient. The applicability of the open curve should, however, be proven by several actual measurements in each case.

At the recent conference of district hydrographic engineers at Washington (January, 1913), Mr. W. G. Hoyt read a paper on 'Methods of estimating stream flow dur-

ing frozen periods of the year, based upon discharge measurements, gauge heights, and a knowledge of climatic and ice conditions.' This paper embodies the latest experience and thought on the determination of winter flow, and an abstract is printed here, with due acknowledgment and thanks to Mr. Hoyt.

"Methods of estimating stream flow during frozen periods of the year, based upon discharge measurements, gauge heights, and a knowledge of climatic and ice conditions.

"When the temperature falls below freezing, numerous conditions affecting stream flow are liable to be produced, which tend to destroy the otherwise fairly constant relation between stage and discharge, thus making it necessary to employ special methods to arrive at the true discharge.

"Measurements of discharge which indicate the flow at the time they are taken, are fundamental in any method for winter estimates. The accuracy of the results will depend largely on the frequency of the measurements, and, in connection with records of gauge heights, temperature, precipitation, and ice conditions, they form the basis for estimates of flow.

"Precipitation is the cause of all run-off, and since temperature is the controlling factor in regulating the rate at which winter precipitation reaches the streams, it follows that temperature is, in general, the most important governing factor and should be given special consideration in making winter estimates of run-off.

"Estimates of stream flow under winter conditions may be made by the following methods:—

"1. By the application of the gauge heights of the water surface to the open water rating, when it is known that the controlling point for the gauge is clear of ice and that no backwater exists at the gauge.

"2. By developing a curve based on discharge measurements and gauge heights to the water surface to which is applied directly the open water gauge heights as taken by the observer.

"3. Basing the flow directly upon discharge measurements, taking into account the climatic and ice conditions,

"(*a*) By the eye method, working directly with the daily discharge, varying it between times of measurement by inspection of the temperature and precipitation records and gauge heights, and adjusting by comparison of results for nearby stations.

"(*b*) By applying the open water rating to the gauge heights and applying to these discharges a co-efficient as determined at times of measurements, varying the co-efficient according to a knowledge of temperature, precipitation, and ice conditions.

"(*c*) By the graphic method, plotting the records of temperature, precipitation with the gauge heights to water surface and determining the amount of correction necessary to apply to the gauge heights in order that the open water rating table may be used, basing the variation in this correction between times of measurements directly on the variations in gauge heights and temperature conditions and modifying the same by records of precipitation and ice conditions.

"The accuracy of method No. 1 depends primarily upon the location of the station. Stations are now located at several points in the United States and Canada at which this method is giving excellent results, but as their number is few, the method can only be used in special cases.

"The accuracy of method No. 2 will depend largely upon the number of discharge measurements and their conformity to a true curve. It is believed

that this method can be used at a smaller number of stations than can method No. 1.

"Method No. 3 will apply at practically all gauging stations which are affected by ice conditions. It may be a matter of opinion as to which of the three different practices, (*a*), (*b*) and (*c*) of No. 3, will give the best results. Method 3 (*a*) is the one now commonly used. Methods 3 (*b*) and 3 (*c*) will, it is believed, give better results than method 3 (*a*), with method 3 (*c*) possibly having an advantage over either of the other methods.

"A discharge measurement taken under ice conditions, when plotted to the open water gauge height, will plot either on the open water curve or to the left, showing that the disturbing conditions result in a backwater effect. Therefore to arrive at the true flow for a given gauge height it is only necessary to determine the magnitude of this backwater effect at the gauge. In general the amount of backwater varies directly with climatic conditions. Having determined accurately the amount of backwater at stated intervals by discharge measurements, it is possible to determine the backwater effect between times of measurement by constructing a curve of backwater which can be drawn by following the gauge heights and the climatic and other conditions which cause the backwater.

"By plotting the daily gauge heights and the backwater curve at the same scale, the corrected gauge heights can be taken off graphically, thus saving considerable time.

"In connection with this study, I wish to advance the following tentative conclusions, based upon observations of conditions in Minnesota since the fall of 1911:—

"1. That ice conditions are apt to cause backwater at the gauge.

"2. That backwater increases rapidly at the beginning of each cold period, partially dropping off later.

"3. That the amount of backwater will tend to vary with the temperature.

"4. That stream flow will drop off suddenly, following a cold period, to be partially regained later.

"5. That stream flow is apt to decrease when temperatures go below 32 degrees, but that the flow tends to increase with any rise in temperature, especially when the minimum temperature goes above 32 degrees F.

"6. That having snow cover on ice may cause increased backwater.

"7. That flow may increase without a raise in gauge height due to the wearing away of the ice.

"Respectfully submitted,

"W. G. Hoyt,
"*District Engineer, U.S. Hydrographic Survey.*

"St. Paul, Minn., January, 1913."

PRECIPITATION IN THE RAILWAY BELT AND ITS RELATION TO RUN-OFF.

The primary source of water supply is rainfall, the chief source of which in British Columbia is evaporation from the Pacific ocean.

Brought from the Pacific by the westerly winds, warm and moist by the influence of the Japan current, the moisture in the air is carried easterly across the province in quantities varying at different times of the year.

Now, all air holds a certain amount of moisture, ranging from the amount sufficient to saturate it to a very small proportion of that quantity. The point of satura-

tion is much higher in warm air than in cold air, that is, warm air can hold a much larger quantity of moisture than can cold air. Whenever air is cooled below the point of saturation, rain falls, and it can only fall when thus chilled.

There are several ways in which air currents may be cooled; the current may be forced upward as when it climbs the slope of a mountain range; it may be cooled by intermingling with colder air currents; and again, by coming in contact with cold land. The sea receives heat slowly and parts with it slowly; the land, on the contrary, is rapidly heated and parts with its heat as quickly. It results from these conditions that the ocean has a fairly uniform temperature the year round, while the land is much colder in winter than in summer.

The west winds come off the Pacific laden with moisture and having the temperature of the ocean. If they encounter land having a lower temperature they are chilled below the point of saturation and some of the moisture is deposited in the form of rain or snow. If, on the other hand, the land is warmer than the air, the air currents pass over it without any reduction in temperature and with little or no loss of moisture.

During the autumn and winter, the Pacific coast is colder than the sea, and hence the copious precipitation which it enjoys at that season of the year. In the summer the conditions are reversed, and the air currents, although containing at least as much moisture as in cold weather, pass over the land with less loss by precipitation.

In the vicinity of Vancouver there are also local conditions affecting the quantity of precipitation, viz.: certain fairly high mountains, which cool the moist air currents and cause abnormal rainfall. This quantity diminishes advancing inland from Vancouver, owing to the upward diversion of the moisture-laden winds, and the lower elevation of the hills, until about 100 miles from the coast the precipitation is so small that an arid district has resulted.

This arid strip is nearly 100 miles in width, and is commonly called the 'Dry Belt' of British Columbia. After passing over this belt, higher mountains are again met and they cool the air, consequently the precipitation in the vicinity of the Selkirk mountains is abnormally large.

In the upper Columbia valley, from Golden to lake Windermere, there is also another arid, or semi-arid district, lying between the Selkirks and the main range of the Rockies. The winds pass from one high range to the other depositing only from 10 inches to 20 inches of precipitation per annum in the valley.

The precipitation in the main range of the Rockies is large (from 60 inches to 100 inches), but not as great as in the Selkirks.

The following is an extract from the *Monthly Weather Review* of the Meteorological Service:—

> 'British Columbia is a territory with very pronounced geographic features, several lofty chains of mountains paralleling the coast from the extreme north to the most southerly boundary. Along the exposed western coast the precipitation is over 100 inches, and eastward over Vancouver island and the mainland the western slopes of the various ranges each claim a much larger percentage of moisture from the Pacific winds than do the valleys and the interior plateaus. Near the more eastern shores of Vancouver island, the annual precipitation ranges between 35 and 50 inches, while across the strait of Georgia in the valley of the lower Fraser, it is generally from 50 to 60 inches. Eastward of the coast ranges the climate of Yale, Kamloops, and the Okanagan district is decidedly drier and the annual precipitation is from 5 inches to 20 inches according to geographic situation. Approaching the Selkirk range the precipitation increases, and at the higher altitudes is very great, chiefly owing to a heavy snowfall between October and April.'

The data of precipitation in British Columbia, as in the other provinces, are derived mostly from the records of the Dominion Meteorological Service, which is a branch of the Department of Marine and Fisheries. The Meteorological Service has its headquarters in Toronto, under the direction of Mr. R. F. Stupart, F.R.S.C. It was organized in 1870, since which time it has carried on extensive observations over nearly the whole of Canada, recording precipitation (rain and snowfall) temperature, pressure, sunshine, wind velocity, etc. In British Columbia, the chief of the Meteorological Service is Mr. E. Baynes-Reed, with headquarters at Victoria. Numerous observation stations have been installed at various places throughout the province, the necessary instruments and equipment being supplied by the Service, and the observations made in some cases by paid, and in others by volunteer, observers. As may be expected, the records of observations are not all complete, but they give a fairly accurate knowledge of meteorological conditions, at least in the settled portions of the province in the main valleys.

The precipitation data obtained by the Meteorological Service has been, with few exceptions, by means of a standard cylindrical rain gauge, the cross-sectional area of which is 10 square inches, the depth of rain being determined by dividing the cubic contents daily by ten. Each gauge is placed in a position as near the surface of the ground as possible, so that the mouth of the gauge is about one foot above the level. The mouth is kept strictly level, and its position such that it is sufficiently removed from any building, tree or other objects that might interfere with the free access of rain, even when it falls with considerable obliquity.

No snow gauge has yet been used, the method of transferring snowfall into precipitation being to assume that on an average 10 inches of snow are equivalent to 1 inch of water.

For hydrographic purposes, precipitation data are extremely valuable. But while it is true that the run-off of any stream is partly a function of the rainfall, it is also so influenced by other incidental and secondary considerations, that a definite relation between rainfall and run-off is almost indeterminate. Let us consider, for example, a small stream discharging from a small uniform drainage area. It would be reasonable to suppose that the largest total run-off of the stream during any year would be the year of greatest rainfall, and similarly for the smallest. But when it comes to establishing a definite relation between run-off and the precipitation, in successive years we find that it depends on various circumstances, such as the distribution of the rainfall—whether during the growing, replenishing or storing periods; the rigour of the winter, the warmth of the summer, the earliness of the spring; and even how the winter set in—whether the frost came before or after the snow, and so on.

It is with extreme caution only that precipitation data can be used for determining the run-off of a stream of one drainage area by comparisons with the known run-off of a stream of a neighbouring drainage. Every stream is a law unto itself, the run-off being influenced by many complex elements, such as geological formation of catchment area, topography, forests, lakes, evaporation, etc.

On the other hand, by using careful judgment and all available data, very close deductions can be made. If we have good hydrographic measurements of the run-off of one stream, and know its drainage area, and the amount of precipitation, we can deduce a fairly reliable run-off for a neighbouring stream, knowing its drainage area and precipitation, especially if we have a few meterings to corroborate our deductions.

Unfortunately, the precipitation data available in British Columbia are insufficient for hydrographic purposes. The rain gauges are nearly all located in the settled communities, in the valleys mostly, and we have no well-distributed records in the higher reaches of the watersheds. High up in hills and mountains the rain and snowfall are as yet unknown quantities, our best deductions and formulæ being unsubstantiated. Consequently, the precipitation recorded near the mouth of a stream is rarely repre-

sentative of the mean precipitation over the whole drainage, and great care should be exercised in drawing conclusions from our limited data.

The mean rainfall given in this report for any stream on drainage area is merely an approximation, deduced with the assistance of the limited precipitation records and our intimate knowledge of meteorological conditions. We have attempted to deduce a relationship between the measured run-off and the approximate precipitation and these deductions may be of some service to engineers and others, remembering always that our deductions are only approximations, and are not extended over a sufficient period of time to be reliable.

It will be noted that the depth of the run-off in inches, as shown in the tabulated records of run-off in some cases almost equals or even exceeds the estimated precipitation. This discrepancy is due to two sources of error in the base data used in these computations. In the first place, the drainage areas are by no means accurate, as has been previously stated. In the second place, the estimated precipitation over the drainage area is probably too small. As has been said, the precipitation stations are mostly in the valleys, and we have no records of or means of determining the enormous precipitation in the higher elevations of the watersheds. This is particularly true in such districts as Stave Lake, Lillooet River, and other watersheds near the coast, where the precipitation probably is 150 or even 200 inches. Again, in the Selkirks and main Rockies, the amount of annual snowfall is enormous, and the streams also derive much of their discharge from glaciers. The relation between the run-off and the indeterminate precipitation cannot be even approximately deduced at present.

Attention is called to a paper read before the sixth annual convention of the Western Canada Irrigation Convention, at Kelowna, B.C., 1912, entitled 'Some climatic factors influencing the use and duty of water,' by R. M. Winslow, Provincial Horticulturist of British Columbia, and published in the proceedings of that convention by the Department of the Interior.

Also to bulletin No. 27 on "The Climate of British Columbia," published by the British Columbia Bureau of Provincial Information.

The precipitation records herein appended are mostly by courtesy of the Dominion Meteorological Service. The records of Jones lake and Lillooet lake are from Messrs. Anderson and Warden, C.E., Vancouver. The Stave lake data are from the records of the Western Canada Power Co. The records of lake Buntzen and Coquitlam lake are by the Vancouver Power Co.

The total yearly precipitation (rain and snow) have been compiled for all precipitation stations whose records are available, some of them extending back to 1891. The monthly precipitation for the years 1911 and 1912 is also given in tabulated form, these being the years during which the Railway Belt Hydrographic Survey has been in operation.

MONTHLY PRECIPITATION for 1911. Precipitation is shown in inches.

Precipitation Station.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Agassiz	4·9	3·6	2·7	2·5	6·6	1·6	1·1	3·0	4·0	3·7	9·1	7·7	51·4
Buntzen Lake	10·1	6·4	9·4	2·3	9·2	3·0	1·0	1·4	10·1	2·6	20·4	21·6	97·5
Chilliwack	9·8	2·8	3·5	2·7	3·6	1·3	1·3	2·1	5·0	1·4	12·9	7·5	53·9
Coquitlam (Jct.)	7·5	4·2	5·1	1·8	5·6	1·8	0·4	1·6	7·0	1·9	12·3	9·7	58·9
Coquitlam Lake	21·6	10·1	9·7	5·6	9·6	4·3	1·4	2·2	9·5	5·4	29·5	23·0	131·9
Enderby	2·4	1·4	0·9	0·4	1·5	1·4	2·1	1·7	1·7	0·2	6·1	3·3	23·1
Glacier	12·9	4·5	7·8	4·1	3·5	2·0	3·5	2·5	2·4	0·2	12·0	8·5	63·9
Golden	4·6	1·8	0·5	0·4	2·5	1·7	1·2	1·3	0·0	1·2	3·3	1·3	19·8
Hope	7·0	3·2	2·8	1·9	2·4	0·7	0·4	3·4	6·2	1·3	12·5	6·1	47·9
Jones Lake				4·2	6·4	2·7	3·3	3·1	10·1	2·1	17·5	7·8	
Kamloops	0·5	0·2	0·1	0·1	1·2	0·2	0·8	1·0	0·9	0·0	2·0	1·3	8·3
Ladner	3·0	2·2	1·9	1·0	5·6	1·1	0·9	0·6	3·0	2·7	7·9	8·0	37·9
Lillooet Lake									8·4	2·8	18·7	13·1	
Monte Creek	0·4	0·1	0·3	0·3	0·1	0·1	0·5	1·1	1·3	0·0	1·9	1·8	7·9
New Westminster	5·4	3·2	3·3	2·3	5·3	2·2	0·7	1·2	4·2	1·9	11·6	9·3	50·6
Nicola Lake	1·5	0·4	0·1	0·3	0·9	0·5	0·3	1·5	1·2	0·3	2·5	1·3	10·8
N. Nicomen	8·2	3·7	5·1	3·0	5·2	1·5	1·6	2·4	7·2	1·8	15·5	9·1	64·3
Revelstoke	7·5	3·3	3·0	0·8	2·6	2·1	2·6	1·6	22·6	0·5	5·1	4·3	36·0
Salmon Arm	3·4	1·3	0·9	0·7	1·4	1·0	1·8	1·4	1·1	0·2	4·0	4·2	21·4
Stevenston	3·7	1·7	1·1	1·5	3·5	1·3	0·5	0·8	2·7	1·2	5·9	5·5	29·4
Stave Falls	9·8	2·7	6·3	2·6	7·3	1·6	2·0	2·8	7·6	2·6	17·8	10·7	73·8
Tranquille	·0	·0	0·2	0·1	1·3	0·1	0·4	1·6	·0	·0	1·9	0·9	6·5
Vancouver	6·1	3·4	3·1	2·0	5·4	2·1	0·9	1·2	4·4	2·2	12·7	8·8	52·3
Vernon (Coldstream Ranch)	1·4	0·9	0·7	0·5	1·7	1·7	1·3	1·4	0·9	0·1	4·1	2·5	17·2
Wilmer	2·1	0·4	0·9	0·3	1·7	1·9	0·7	1·7	·0	0·4	1·1	0·3	11·5

MONTHLY PRECIPITATION for 1912.

Precipitation Station.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Agassiz	4·3	10·6	2·0	4·3	4·0	5·9	5·1	7·8	2·5	7·3	13·8	10·1	77·7
Armstrong	2·6	1·4	0·1	1·2	0·5	1·9	1·9	1·4	0·9	1·8	3·3	2·5	19·5
Ashcroft									0·5	0·7	0·5	0·4	..
Buntzen Lake	15·9	10·1	3·0	6·7	3·2	4·6	2·6	5·2	4·7	11·4	19·1	19·0	108·5
Chilliwack		5·4	1·1	2·1	1·5	2·2	2·2	5·1	1·2	6·7	10·8	7·1	50·0
												(approx.)	
Coquitlam (Jct.)		6·2	1·1	4·3	2·5	2·4	2·0	5·5	2·7	5·8	11·5	11·3	62·0
											(approx.)		
Coquitlam Lake	21·7	15·5	2·1	10·0	3·7	5·6	2·7	9·5	6·7	13·6	29·3	26·7	..
Enderby	3·2	1·2				0·9	2·2	1·3	1·0	1·4	2·0	2·4	147·1
Glacier	7·9	7·8	1·2	1·7	1·7	2·5	4·3	8·6	2·3	5·3	10·9	5·4	59·6
Golden	1·9	0·4	0·1	0·8	0·7	1·3	2·8	3·9	1·0	0·7	2·1	1·8	17·5
Hope	6·4	5·1	1·1	10·4	0·7	1·7	2·8	4·1	0·7	6·6	10·2	3·9	53·7
Jones Lake	8·8	8·7	2·4	2·9	3·9	4·4	5·9	7·0	2·1	11·7	24·3	17·3	99·4
Kamloops	1·2	0·6	·0	1·4	0·3	1·5	3·5	2·1	0·9	0·7	0·8	0·5	13·5
Ladner	4·7	3·8	0·3	1·8	0·9	2·0	1·9	3·2	1·8	4·1	5·5	4·8	34·8
Lillooet Lake	11·5	9·7	1·6	6·2	3·9	4·3	3·0	8·0					91·2
												(approx.)	
Monte Creek	1·4	0·1	·0	1·5	0·3	0·7	2·0	1·3	1·1	0·8	0·8	0·6	10·6
New Westminster	8·3	6·0	0·6	·43	2·3	2·8	1·8	6·3	2·1	6·0	8·3	8·5	57·3
Nicola Lake	1·2	0·8	0·1	1·5	0·8	0·9	1·6	2·0	1·0	1·1	1·2	0·5	12·7
Nicomen	10·1	6·2	1·1	3·2	2·1	2·9	2·8	6·6	1·3	6·9	13·2	8·5	64·9
Revelstoke	5·2	3·3	0·8	1·9	1·9	2·3	4·1	4·0	1·5	5·0	6·0	8·2	44·2
Salmon Arm	2·8	1·2	·0	1·3	0·5	·09	2·1	2·5	1·0	1·0	2·2	2·0	17·5
Steveston	5·5	3·3	0·4	2·4	2·2	1·5	1·6	4·5	2·0	4·2	6·2	5·4	39·2
Stave Falls	6·9	6·7	1·7	2·9	2·6	3·3	3·9	6·2	2·2	7·7	13·6	10·0	67·7
Tranquille	0·7	0·4	·0	1·2	0·5	0·7	2·4	2·3	0·7	0·2	0·1		9·2
												(approx.)	
Vancouver	8·5	6·2	0·9	3·0	2·3	2·3	1·5	5·9	2·8	4·6	9·2	8·8	56·0
Vernon (Coldstream Ranch)	2·4	0·9	·0	1·1	0·8	1·3	2·6	1·2	0·7	1·2	1·4	1·2	14·8
Wilmer	1·1	0·1	·0	0·3	1·1	1·7	3·9	1·5	1·3	0·7	0·9	0·5	13·1

ANNUAL PRECIPITATION at various Precipitation

Precipitation Station.	Elev. Feet.	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
Abbotsford	50	68·6	55·5	67·8	71·5	56·2	56·2	57·9	50·3	65·0	Abandoned	
Agassiz	52		67·8	80·0	68·0	50·9	68·2	60·1	50·2	69·0	70·0	53·0
Armstrong	1,200											
Ashcroft	1,000											
Buntzen Lake	400											
Chilliwack	21											
Coquitlam Jct	34											
Coquitlam Lake	450											
Enderby	1,180				19·3	20·6	18·5	21·9	24·0	28·0	22·5	
Glacier	4,072				58.6	55.7	56.0					
Golden	2,550											
Hope	500											
Jones Lake	1,900											
Kamloops	1,245					9·5	11·5	12·7	9·8	11·6	10·8	7·1
Langley	60						66·7	61·8	54·2	67·9	Abandoned	
Ladner	30								29·2			
Lillooet Lake	370											
Monte Creek	1,160											
Nicola Lake	2,120	11·1	10·8	11·4	8·1	9·3	10·6	13·3	9·6	14·5	14·4	9·1
N. Nicomen	59			90·1	96·8	77·6		74·5	71·9	81·5	84·3	74·2
Revelstoke	1,476									46·6		
Salmon Arm	1,152				12·9	16·9	16·6					
Spences Bridge	770	8·9	7·9	8·9	13·5	7·9	5·5	(Abandoned).				
Steveston	20											
Stave Falls	200											
Tranquille	1,120											
Vancouver	136										71·5	
Vernon (Coldstream)	1,246						12·5		9·7			
New Westminster	330					41·7	46·2	55·0	54·9		69·2	63·5
Wilmer	2,700											

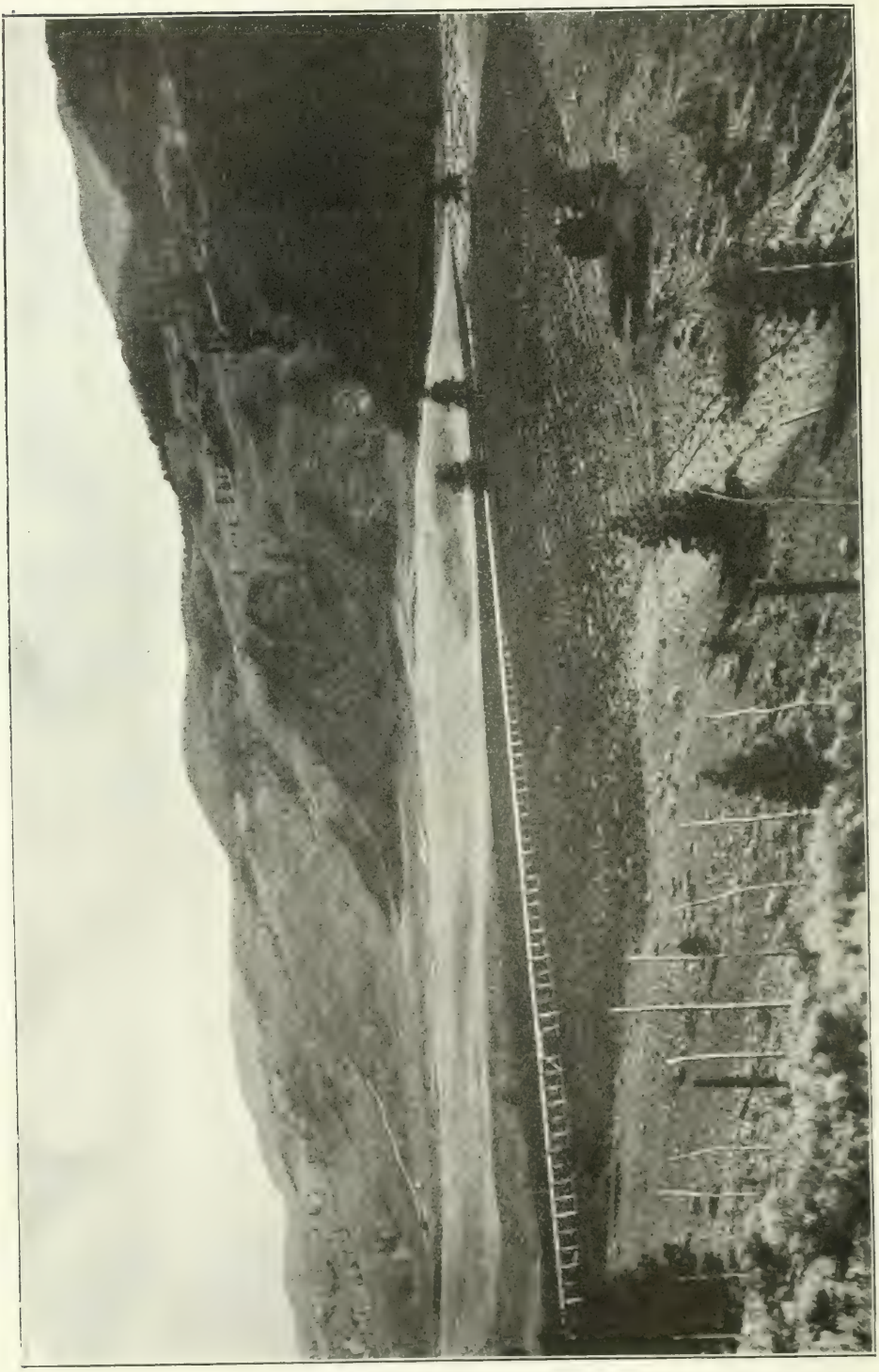
NOTE.—Precipitation is shown in inches and includes rain and snowfall, 10 inches of snow assumed equivalent to 1 inch of rain.

* Approximately.

SESSIONAL PAPER No. 25f

Stations in the Railway Belt, British Columbia.

1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	Mean	Remarks.
											61·0	Mean of 9 years.
54·7	57·7	54·7	60·6	64·9	61·7	47·5	63·7	57·0	51·4	77·7	61·4	" 21 "
										19·5	19·5	1 year only.
	121·4	109·3	116·1	137·6	106·6	112·2	105·8	114·5	98·6	108·8	113·1	Established 1912. Mean of 10 years.
									53·9	45·0	49·5	" 2 "
77·5	74·7	75·6	66·1	75·7	70·4	72·7		75·9	58·9	62·0	71·0	" 10 "
	146·2	156·6	144·5	189·9	147·2	170·8	159·9	159·6	132·0	147·1	155·4	" 10 "
								21·4	23·1		22·1	" 3 "
48·6						65·0	*60·0	70·2	63·9	59·6	59·7	" 9 "
							21·5	21·0	19·8	17·5	20·0	" 4 "
								53·4	47·9	53·7	51·7	" 3 "
										99·4	99·4	" 1 "
12·0	10·8	10·8	8·4	11·1	8·9	7·5	9·6	7·7	8·3	13·5	10·1	" 18 "
											62·6	" 4 "
35·2			37·7		35·3	39·6	35·3	34·5	37·9	34·8	35·5	" 9 "
										91·2	91·2	" 1 "
								10·3	7·9	10·6	9·6	" 3 "
13·4	14·0	10·9	10·3	10·7	12·5	7·5	10·3	10·1	10·8	12·7	11·1	" 22 "
72·2	81·5	70·6	67·1	70·1	64·7	63·7	74·9	86·3	64·3	64·9	75·3	" 19 "
			37·4	40·2	49·1	42·9	41·1	46·2	36·0	44·2	42·6	" 9 "
					21·8	15·6	21·5	18·4	21·4	17·5	18·1	" 9 "
											8·8	" 6 "
							33·1	38·1	29·4	39·2	34·9	" 1 "
								90·6	73·8	67·7	77·4	" 3 "
								4·7	65·	*9·2	6·8	" 3 "
65·3	60·6			58·0	57·6	62·7	59·5	59·4	52·3	56·0	60·2	" 10 "
	18·0	11·0	13·0	14·9	18·6	10·4	14·0	15·3	17·2	14·8	14·1	" 12 "
63·2	57·6	59·1	53·4	59·2	55·3	57·7	59·1	60·7	50·6	57·3	56·7	" 17 "
							*11·0	8·0	11·5	13·1	10·9	" 4 "



Smith-Curtis Irrigation Project, Savona.

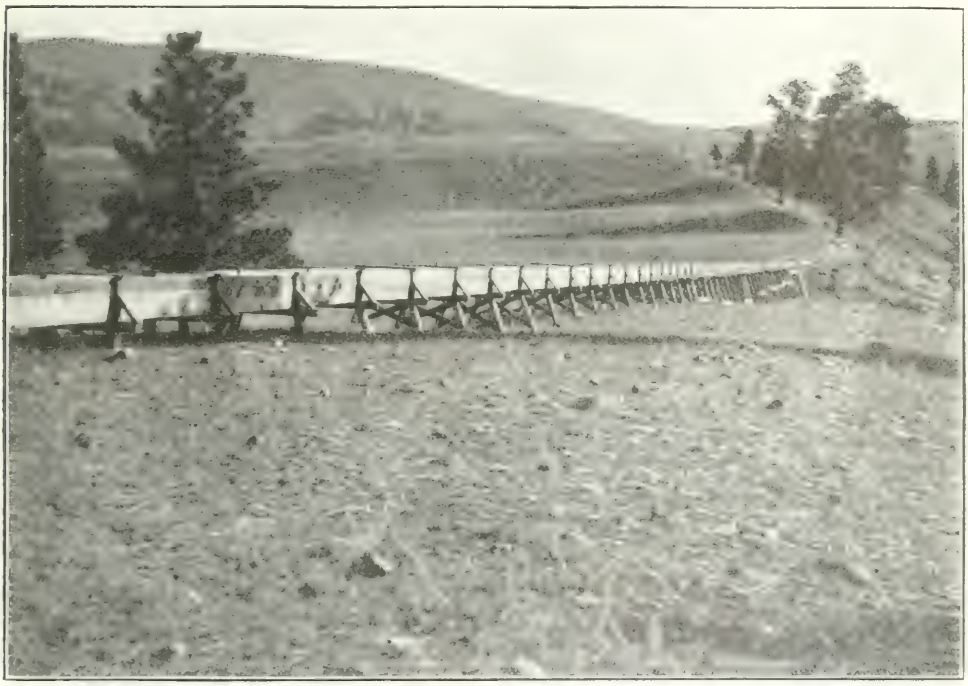
DRAINAGE AREAS.

The drainage areas of streams in the Railway Belt have been determined from the best available maps; but in many cases cannot be considered very reliable, as often the only map obtainable was not designed with the intention of showing the mountains and contours with sufficient accuracy to delineate the watershed.

The principal maps used have been: The Dominion sectional sheets (3 miles to an inch); Wheeler's maps of the Selkirks and Rockies; and the Geological Survey map (1895) of the Dry Belt, showing contours.

For the larger rivers, such as the Fraser, Thompson, Columbia, and those that rise in the province and only pass through the Railway Belt, it was necessary to resort to the best provincial maps, most of which are on a very small scale.

The computations in all cases were done with a planimeter.

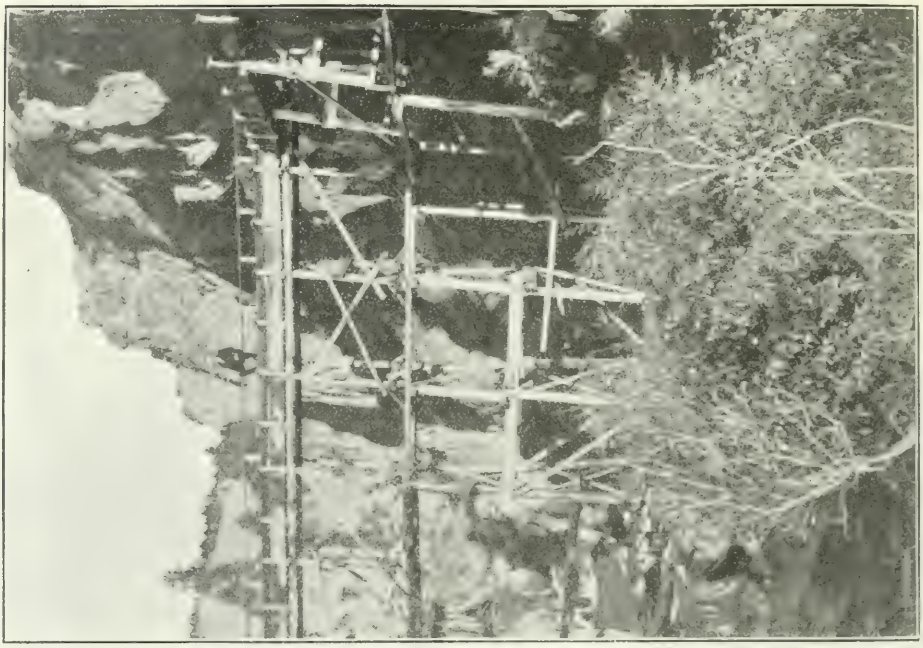


Smith Curtis Irrigation Project, Savona, B.C.

IRRIGATION IN THE DRY BELT.

The nature and extent of the "Dry Belt" of British Columbia have been already discussed herein under the heading "Hydrographic Districts in the Railway Belt," with particular reference to that portion of the dry or arid district lying within the confines of the Railway Belt. In this arid belt, about 100 miles wide east and west, the precipitation is only from 9 to 12 inches per annum, and irrigation must be practised for nearly all agriculture and horticulture. By irrigation is meant the artificial watering of crops whether by means of a garden hose or the most elaborate system of irrigation works; reservoirs, headgates, canals, flumes, ditches, laterals, etc.

As this report is essentially that of a hydrographic survey it purports to deal only with that branch of the science of irrigation which embraces the study of the available



Smith Curtis Irrigation Flume through Canyon, Deadman River, near Savona, B. C.

Smith Curtis Irrigation Project, Earthen Ditch.

water supply, its use and conservation. When the Hydrographic Survey of the Railway Belt was inaugurated, after the Judicial Committee of the Privy Council had decided that the administration of water and water rights in the Belt was a Dominion responsibility, a commencement was made to form an efficient water administration and, as well, to study the whole science of irrigation, including those branches connected with the construction of works (reservoirs, dams, canals, distributing systems, etc.); the proper laying out of irrigation farms; and the beneficial application of the water to the crops and soil to insure the best and largest yield per unit of water and per acre of land. But, after the transfer of the administrative authority over water and water rights in the Railway Belt from the Dominion to the province, these latter branches of irrigation became more especially a provincial responsibility. Moreover, the practice of irrigation in the 'Dry Belt' has been extensively written upon and discussed in numerous provincial bulletins and reports, such as the report of the British Columbia Minister of Lands, 1912; Bulletin No. 44 of the British Columbia Department of Agriculture, etc., while the whole science of irrigation has been so exhaustively studied in the several arid states of the American union that almost the last word thereon can be found in the various books and pamphlets issued by the state and federal governments, particularly in the valuable publications of the United States Department of Agriculture.

It may be remarked, however, en passant, that irrigation as it is practised in the 'Dry Belt' of British Columbia can scarcely be called a science. Except in the cases of the large and recently organized irrigation companies, the irrigation works are not of the most approved type; the losses of water in transmission are excessively large; the distributing systems are the evolution of expediency; only rude attempts have been made to lay out the lands for the proper application of the water; generally too much water is used; and it has been only by bitter experience that the farmers have learned what crops should be grown on certain soils and under certain conditions of subsoils, slope, elevation, exposure, climate, etc. If there is one district in Canada that needs a Government experimental farm it is the 'Dry Belt' or irrigation district of British Columbia.

THE DUTY OF WATER FOR IRRIGATION.

The duty of water is expressed by the area of land that a unit of water will irrigate.

This varies according to many circumstances: soil, subsoil, altitude, slope of land, drainage conditions, nature of crop, etc.; and also differs in different countries and localities.

Hence, it is almost impossible to state a definite duty of water for any large district, irrespective of the varied conditions. The following table will give some idea of the relative duties in many countries and states:—

Locality.	Duty per sec.-ft. (in acres).
Northern India	60 to 150
Italy	65 to 70
Colorado	80 to 120
Utah	60 to 120
Montana	80 to 100
Idaho	60 to 80
New Mexico	100 to 150
Southern Arizona	100 to 150
San Joaquin Valley (California)	100 to 150
Southern California	150 to 300
Southern Alberta	.. 150

In the 'Dry Belt' of British Columbia, the soil is mostly a light sandy loam with a sandy or gravelly subsoil, and the irrigable land requires a good supply of water.

The elevation varies from 800 to 2,500 feet above the sea. The bench lands, on which most of the fruit is grown, are of this kind. Owing to the slope and the nature of the subsoil, the drainage is good, and there is little possibility of alkali, or of souring the land. The bottom lands are mostly sandy also, with some clay, black loam or humus. These lands are used for hay, grain or mixed farming, but unfortunately some valuable tracts have been temporarily spoiled by too much water, resulting in deposits of alkali.

These, of course, are general statements, and do not include all the varied conditions of soil and crops. A conservative estimate of the duty of water for the British Columbia dry belt is as follows:—

Crop.	Acre-feet of water in an irrigating season.
Hay and fodder	2½ to 3
Grain and root crops	2 to 2½
Fruit	1½ to 2

These quantities of water indicate the amount of water actually applied to the land and crops. There is a goodly percentage of water lost in transmission, etc., between the diversion from the source of supply and the actual irrigation. Hence, in all calculations for the amount of water that must be taken from a stream or reservoir to irrigate a certain acreage of land in a certain crop, allowance must be made for all losses.

It is not proposed to enter into a lengthy dissertation on the duty of water. It is a question that must receive much future study in British Columbia, and he would be dogmatic indeed who would attempt to fix a law at the present time. Many interesting and valuable pamphlets and articles have been written on the subject by irrigationists and engineers, all of which assist to throw some light on the subject. Reference should be made to these by anyone interested.

The following publications on the duty of water are recommended:—

A paper in the "Eighth Biennial Report of State Engineer of Idaho" (Boise, Idaho, U.S.A.).

Circular No. 108, by Frank Adams, of the United States Department of Agriculture; office of Experiment Stations.

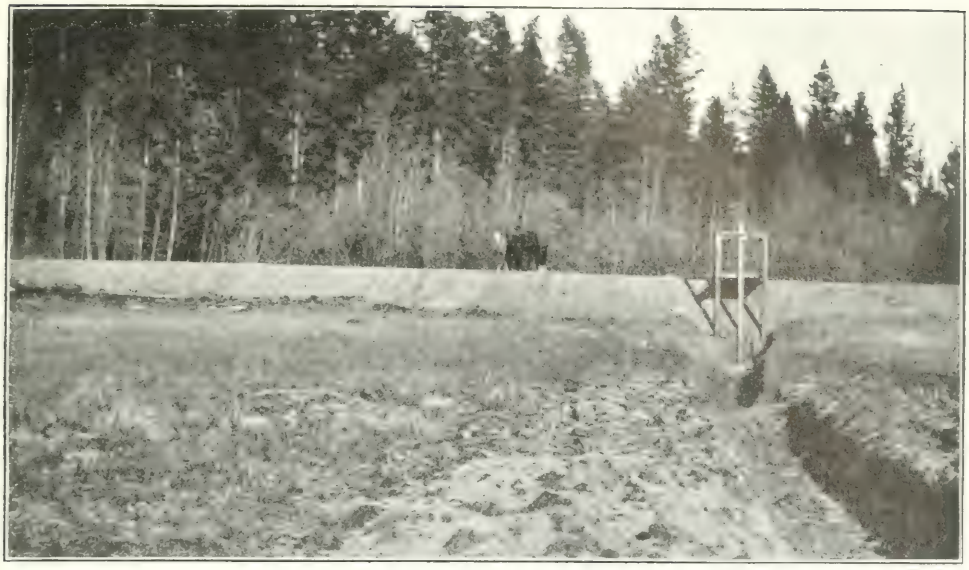
Bulletin No. 172, by S. Fortier, of the United States Department of Agriculture; office of Experiment Stations.

Bulletin No. 44, British Columbia Department of Agriculture (B. A. Etcheverry), with special reference to British Columbia.

STORAGE AND STORAGE WORKS.

Storage reservoirs are essential to the beneficial conservation and regulation of the run-off of nearly all streams, whether in a humid or arid district. For water-power projects efficient storage is important to increase the natural minimum flow. In British Columbia, the majority of streams on which power can be developed have excellent natural storage lakes situated above the power sites. For example, Coquitlam lake, Stave lake, Lillooet lake, Chehalis lake, Jones lake, Adams lake, Barrier lake, and Mabel lake. And in nearly every case a good dam site is obtainable, where a dam can be constructed almost to any desired height, and the greater portion of the flood flow conserved and stored for the low-water period.

The construction of a large storage dam for power purposes is an important engineering feat, the particular kind of dam depending on the circumstances. Probably the most interesting dam in British Columbia is the hydraulic earth-fill dam now under construction by the Vancouver Power Company at the outlet of Coquitlam lake.



Cherry Creek Estate, Irrigation Storage Dam.

Cherry Creek Estate, Irrigation Dam.

This dam is about 850 feet long at its crest and 40 feet wide. It will have an extreme height of 98 feet. It will raise the level of Coquitlam lake 60 feet and will give the lake a storage capacity of 175,600 acre-feet. For a complete description of this dam, and the Coquitlam-Buntzen Hydro-electric Power Development, see the *Canadian Engineer* for October 10, 1912.

For the irrigation of arid lands storage is very important. In fact, it may be said that the storage of the surplus waters of the spring freshet is probably the solution of the present water scarcity, and on such conservation depends the future development of the 'Dry Belt.' Whether the storage works are constructed by the government, by large irrigation companies, by the co-operation of irrigators, or by individual farmers, every encouragement should be given by the Government to further this

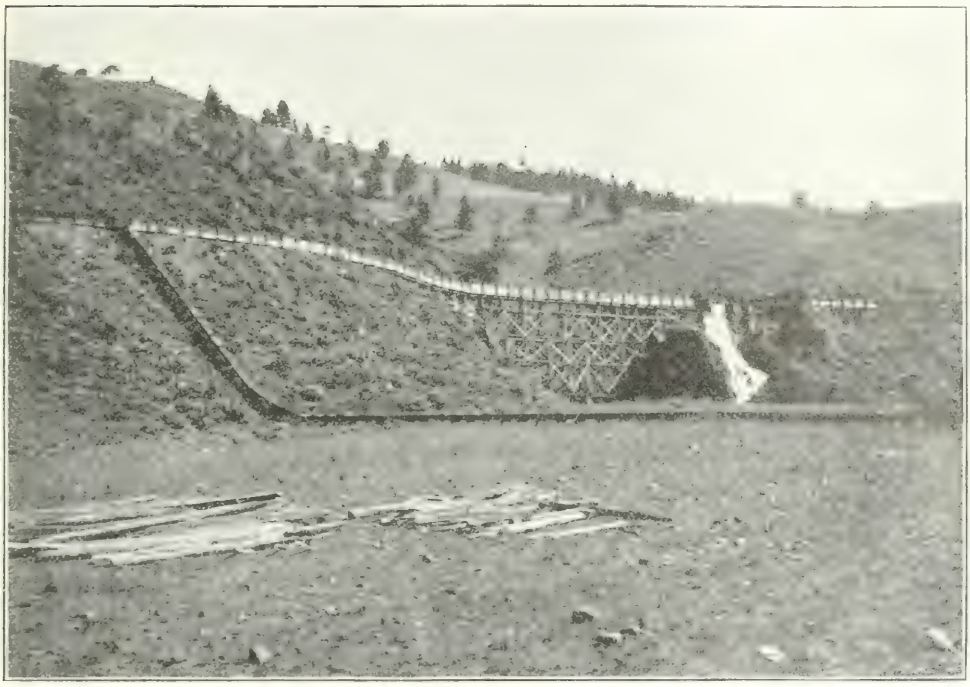
Flume of the Barnes Canal (Looking up Deadman River).

important work. All storage sites should be investigated by Government engineers. They should be surveyed and contoured, and their capacity calculated. The best dam site should be carefully chosen, and the nature and cost of the most suitable dam determined. From the hydrographic data of stream flow, it can be ascertained whether or not there is sufficient water to fill the reservoir, etc. The plans and specifications of all dams and storage works should be approved by Government engineers, and the actual construction and future maintenance of the dam inspected. Every storage project should be considered by the Government with reference to the future possibilities and requirements of the water supply affected and the lands to be irrigated.

During the freshet of 1912, several small storage dams in the 'Dry Belt' failed, and the escaped water caused serious damage in its rush down the valleys. Moreover, much valuable water was lost. All dams should be inspected by Government engineers to ensure safety.

All irrigating farmers should have some knowledge of the different kind of dams that are suitable for small storage works for irrigation purposes. The more they learn of this subject the less likely they will be to attempt the construction themselves in their own primitive way, and they will see that it pays in the long run to secure good engineering advice. There are a number of excellent books and pamphlets on the subject of dams, to which reference should be made.

Bulletin No. 249, (Parts I and II) of the United States Department of Agriculture (Office Experiment Stations) on 'The Storage of Water for Irrigation Purposes —Earth-fill Dams, Hydraulic-fill Dams, Timber Dams and Rock-fill Dams' may be specially recommended.



Barnes Estates, Limited, Walhachin, B. C. Irrigation Flume, showing Escape-gate and Distributing Lateral.

EVAPORATION FROM WATER SURFACES.

The amount and rate of evaporation from water surfaces is an important factor in storage problems, particularly in an arid or semi-arid district. The rate of evaporation depends chiefly on the temperature of the water, the temperature and humidity of the surrounding air, and the wind velocity.

While there have been deduced certain empirical formulæ for determining the evaporation, it is much more satisfactory to measure it directly by means of evaporation pans. The simplest form of evaporation pan is probably the best. It consists of a shallow pan of known dimensions. It is placed floating on the pond, lake or other water surface, and generally supported by a skeleton raft which prevents splashing by wave or wind action. The amount of water evaporated daily from the partially-filled pan is measured by means of a small vessel whose cubical contents are some con-

venient fraction of those of the pan. The amount of water evaporated is equivalent to the amount that must be added to bring the surface of the water in the pan back to normal. The amount of evaporation is expressed in inches of depth. Due allowance must be made for the daily rainfall. In addition to the evaporation pan, the following instruments are necessary to complete observations at each station: Rain gauge, thermometers, barometer, and wind gauge.

No studies of evaporation have been made in British Columbia, and it is recommended that a number of stations be started, particularly in the 'Dry Belt,' some in the low valleys and others at the higher elevations in the hills, where most of the storage and reservoirs are situated.

British Columbia Horticultural Estates, Thompson River at Walhachin. Suspended Wood-stave pipe. Span: 750 feet. Capacity: 5 sec. feet.

In general, evaporation from water surfaces is more rapid where the mean annual temperature is greater, and in places of lesser rainfall. The evaporation from water surfaces in the humid coast district is probably about 20 to 30 inches per annum, which is more than compensated for by the precipitation. In the arid districts of the 'Dry Belt,' the evaporation from an open reservoir, with few trees along the banks is probably from 80 to 100 inches. The average evaporation is fully 70 inches, most of it taking place from May to September.

SEEPAGE AND LOSSES IN TRANSMISSION.

In ordinary irrigation, as practiced in the 'Dry Belt' of British Columbia, not more than 50 per cent of the water that is diverted from the natural bed of a stream actually goes to irrigate the land for which it was taken. On account of the extreme

Western Canadian Ranching Company's Irrigation Farm, near Kamloops, B. C.

Western Canadian Ranching Company Manager's Residence, near Kamloops, B. C.

dryness of the district, water is a very valuable commodity, and it is evident that the loss of half of it is a serious condition of affairs. No wonder there is a cry of water scarcity, and no wonder it is claimed that there is insufficient water for lands at present undeveloped. This enormous loss in transmission is due mostly to seepage in unlined earthen ditches. In an arid country like the British Columbia 'Dry Belt' the subsoil is generally sand or gravel which is very porous and allows the water to readily seep through it. The amount of seepage is also dependent on the shape of the ditch, its slope, its age, the amount of silt in the water, etc.

Irrigation in the 'Dry Belt' is mostly carried on by individual farmers with small individual ditches, carrying anywhere from one to twenty second-feet, and it is in these small ditches that the proportionate loss by seepage is the greatest. Especially as the ditches are very crudely constructed, with no recognized or proper slope or shape.

To prevent this enormous loss of water by seepage it will be necessary for the Government to insist on all irrigation works being constructed and maintained according to the most modern methods. Irrigators should be instructed and advised regarding the construction of their ditches so that they may know the size of ditch, capacity and slope for the acreage to be irrigated and the nature of the ground through which the ditch must pass. The critical velocity for different kinds of soils and subsoils is also very important.

Even where earth ditches are well constructed, the seepage losses are great, and it will be necessary to resort to various plans to save the water, such as puddling by silt or cement, or lining with concrete, wood or steel.

During the measurements of the many irrigation streams in the 'Dry Belt,' the farmers continually called attention to the 'sinking' of the water in the natural bed of the streams. The water of many small creeks simply disappears to come out again a hundred yards or even a mile or so below. Numerous measurements were made at different points on a creek, and the point of sinking and reappearance located, together with the amount of loss.

In some cases the sinking is certainly an inconvenience to a farmer, but he seems to worry much more over this natural sinking than he does of the seepage losses in his own ditch. It will be necessary in some instances for the farmers to construct their intakes above the point of sinking; in others the water users or the Government will have to construct ditches or flumes to convey the whole flow over and past the danger points.

See Bulletin No. 44, British Columbia Department of Agriculture, page 32, for 'Conveyance losses of water in canals.'

IRRIGATION BY PUMPING.

The water supply for irrigation in the 'Dry Belt' of British Columbia is obtained almost entirely by gravity from small streams and lakes rising in the hills above the farm lands. The first lands to be taken up and cultivated were naturally those in the main valleys near the mouths of the best tributary creeks, and the earliest and dominant records for water are appurtenant to these lands, often commanding the whole flow of the particular stream. Later on, the higher bench lands were taken up, but the supply of water was dependent on the needs of the first-mentioned valley lands, and the development of the bench lands has been necessarily very slow.

The future development of these large areas of high bench lands depends to a great extent on the release of the water from the lower valley lands, the latter obtaining their supply by pumping from the unlimited sources of supply of the main rivers, such as Thompson and Fraser.

Moreover, there are also thousands of acres of excellent irrigable lands in the large valleys, lying adjacent to the large rivers, which have no gravity supply from adjacent tributary streams, and are idle and non-productive.

Irrigation by pumping has been extensively and successfully practised in some of the arid states of the United States, but as yet has only been experimented with in British Columbia, probably because the energies of the farmers have been directed mostly to obtaining a gravity supply, and perhaps on account of the high cost of fuel (gasolene, crude oil, coal and hydro-electric power) in British Columbia.

In spite of the great cost of installation and operation, there is no doubt that several thousands of acres of lands in the Thompson valley could be economically irrigated by pumping, in the majority of cases the lift being only from 25 to 75 feet.

Western Canada Ranching Company's Fruit Lands.

Cheap hydro-electric power from Adams river would be a tremendous boon to the agricultural development of the Thompson valley, and this excellent power should not be granted to any company without due consideration of this feature.

The subject of irrigation by pumping has been dealt with in numerous publications, the principal ones being: Farmers' Bulletin No. 394, Bulletin No. 201, and Bulletin No. 236, of the United States Department of Agriculture.

In Bulletin No. 44 of the British Columbia Department of Agriculture, irrigation by pumping has been discussed with special reference to British Columbia. All costs have been estimated for British Columbia. Special attention is called to this article.

WATER-POWERS.

As might be expected in a mountainous country like British Columbia, there are excellent water-power possibilities in the Railway Belt. This is particularly so in the humid coast district, where the precipitation in some places is as great as 150 to 200 inches per annum, and the run-off is over 100 inches in depth on the drainage area. There are no severe winter conditions, except in the highest elevations of the watersheds. Most of the streams rise in the mountains at an elevation of from 5,000 to 7,000 feet, and discharge into Fraser river near mean sea-level. There are generally numerous falls and rapids where power can be practically and economically developed and a head of anywhere from 100 to 600 feet obtained. Fortunately, too, many of the rivers

Irrigable Lands, South Thompson Valley, near Kamloops, B. C.

broaden into large lakes in their course, which would serve as excellent storage reservoirs, for example, Coquitlam lake, Lillooet lake, Stave lake, Chehalis lake, etc. In the coast district the minimum period of flow occurs in March, although there is also a low stage in August or September. There are two freshet periods also, the larger in the spring about May or June, and the other a flashy flood in the late fall, about November.

In the 'Dry Belt' there are really no large water power developments possible. The precipitation is small, ranging only from 10 to 20 inches, and the percentage of run-off is much smaller than at the coast, in most cases being only from 20 to 30 per cent of the precipitation. The streams all have two low periods, one in July and August and the other for fully three months during the severe winter. The spring freshet is very large, generally taking place about the middle of May. Storage possibilities are only fair, being mostly small lakes near the headwaters of the streams.

where the catchment basin is small. The exigencies of irrigation in the 'Dry Belt,' demanding the use of the water in the summer, do not concur with the requirements of water power.

In the Shuswap Lake district there are a number of good power developments possible, Adams river, for example, to which reference has been made elsewhere in this report. The run-off in this district is about 60 per cent of the precipitation, which ranges from 40 to 80 inches per annum. The minimum period occurs in March, although the run-off during the four winter months is small. Winter conditions exist for about three months, although some years the winter is very mild.

In the Columbia district there are water-power possibilities on nearly every stream that rises in the mountains and empties into the large arteries. In only very few cases, however, are there good storage reservoirs. Winter conditions are exceptionally severe. During the four winter months there is a very low stage in the run-off. The maximum period is during July and August when the snow on the mountains is melted.

(A) DEVELOPED WATER-POWERS.

Following is a list of the developed water-powers in the Railway Belt. Except the first two these are mostly very small developments, ranging from 50 to 300 horse-power. Reference has been made to these power developments under the headings of their respective streams.

Coquitlam-Buntzen plant, from Coquitlam lake and Buntzen lake.

Stave falls.

Small industrial and lighting plant by the C.P.R. at North Bend.

Small industrial plant on Murray creek, near Spence's Bridge.

Small power plant on Bonaparte river, near Ashcroft, used in the town of Ashcroft for lighting, etc.

Municipal plant on Barrier river by the city of Kamloops. This plant is now under construction. It is located outside the Railway Belt, about 45 miles from Kamloops. (2,000 to 5,000 horse-power).

Small lighting plant on Fortunes creek by the town of Armstrong.

Small lighting plant on Crazy creek at Taft, B.C.

City of Revelstoke power plant on Illecillewaet river, near Revelstoke. (750 horse-power.)

Small industrial plant on Mill creek, near Arrowhead. Only used when the mill is in operation.

Small lighting plant for Glacier House at Glacier.

Small mining plant on Cathedral creek, near Field, by the Mount Stephen Mining Syndicate.

For a detailed description of these plants see the forthcoming report of the Commission of Conservation on "The Water-powers of Western Canada."

(B) UNDEVELOPED WATER-POWERS.

In estimating the amount of available horse-power on any stream or in a district we must consider as well:—

(1) The present economic value of the water-power, including the present market, the practicability and cost of development and the relative cost of fuel power.

(2) The future economic value, with regard to the growth and development of the surrounding country, the probably increased efficiency of power plants and the future price of fuel power.

While at the present time the first consideration is seemingly of prime importance, yet a wise Government should look to the future, and inventory the maximum uses to which such a great natural resource as water-power can be placed. No power development, for instance, should be allowed at the present time which will prevent the same or an adjacent site from being some day developed to its maximum capacity, looking to the time when the people of the country, who are the real owners of all the natural resources, shall be driven by the exigencies of fortune to the use of all the water-power that can be reasonably produced. The time is coming soon when the "white coal" of British Columbia will be utilized to the last degree.

The present and future water-power possibilities of some sixty streams, large and small, were investigated by the engineers of the Railway Belt Hydrographic Survey, a reconnaissance of the available head, the storage possibilities, the power and dam sites, the maximum, minimum and mean flow, being made. This information was furnished to the Commission of Conservation, and will appear in the forthcoming report of that Commission on "The Water-powers of Western Canada," and it would only be superfluous to publish it here.

RECLAMATION AND DRAINAGE.

Owing to the mountainous nature of the Railway Belt, with the main rivers running in well-pronounced beds, and the valley lands sloping toward the rivers, there are not many districts where large tracts of overflow or swamp lands exist. In the lower Fraser valley, however, there is considerable land that is subject to periodical overflow during the flood period of the Fraser and its tributaries in June and July. The Pitt river meadows lie adjacent to Pitt river, which is a tidal stream affected by the Fraser river flood waters. Most of these lands have already been reclaimed by dyking, and other parts are being reclaimed at the present time by the construction of elaborate dykes and ditches.

On the south side of Fraser river is the Chilliwack Sumas district, where from 30,000 to 50,000 acres of valuable agricultural lands are subject to periodical or occasional overflow from the Fraser and Chilliwack rivers. Parts of these lands have been successfully reclaimed, and an extensive project, the Sumas dyking scheme, is now in contemplation whereby the remainder of the district, comprising nearly 30,000 acres, will be dyked and rendered free from flooding. This project will necessitate the diversion and control of Chilliwack river, which now enters Sumas lake via the Vedder channel; the construction of extensive dykes to prevent the ingress of the Fraser floods; and the pumping and draining of Sumas lake, a shallow lake of about 9,000 acres.

Projects of this kind are carried on under the regulations of the provisional drainage, dyking and irrigation act.

In the upper Columbia valley from Golden to Windermere (a distance of 80 miles) the river runs through a valley from half to one and one-half miles wide. In June, July and August, the river is in flood and the bottom lands were covered to a depth of from one to three feet. See discussion on "Columbia river above Golden." By straightening, dredging and dyking the Columbia river and controlling the flood flow of such tributaries as Toby creek, Horsethief creek, No. 2 creek, Bugaboo creek and Spillimacheen river, as well as a few small streams, fully 40,000 to 50,000 acres of now useless lands could be reclaimed and turned into good agricultural or hay lands.

The records of run-off in the upper Columbia valley obtained by the Hydrographic Survey will be of great value to this project when the time comes for its undertaking.

The subject of drainage of irrigated land is not discussed here, and reference should be made to the various pamphlets issued by the United States Department of

Agriculture. The principal bulletins on this subject are: Farmers' Bulletin No. 371, Bulletin No. 217 and Bulletin No. 240.

The greater part of the irrigated bench lands in the Dry Belt are sloping lands with gravelly subsoil, which do not require surface or under drainage. But the more level bottom lands need careful watching. It is now accepted by all scientific irrigationists that too much water is generally applied to irrigated land, with no drainage, the land often becomes strongly alkaline, or scur, and is rendered almost unfit for agriculture.

PART II

HYDROGRAPHIC DATA OF STREAM FLOW.

DEFINITIONS OF TERMS.

The volume of water flowing in a stream—called the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, miner's inches, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet.

The units used in this report are second-feet, second-feet per square mile, run-off in inches and acre-feet. They may be defined as follows:—

"Second-feet" is an abbreviation for cubic feet per second (c.f.s.) and is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed by the use of factors given in the following table of equivalents.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches

"Acre-foot" is equivalent to 43,560 cubic feet, which quantity is the number of square feet in one acre. It is the quantity of water required to cover an acre to the depth of 1 foot, and is the common unit of measurement of quantity. It is generally used in connection with storage.

"Miner's inch" is a unit of measurement representing a rate of flow, and although it is in common use in British Columbia, it is, unfortunately, not a good unit. It differs in various parts of America, and in British Columbia is defined as follows:—

> "A miner's inch is the quantity of water that will pass through an orifice two inches high and one-half-inch wide made in a two-inch plank, the water to have a constant head of seven inches above the upper side of the orifice, and every additional inch of water shall mean so much as will pass through the said orifice extended horizontally half an inch."

A second-foot is equal to 35·71 British Columbia miner's inches.

The following is a list of convenient equivalents for use in computations:—

CONVENIENT EQUIVALENTS.

1 second-foot equals 35·71 British Columbia miner's inches, or one British Columbia miner's inch equals 1·68 cubic feet per minute.

1 second-foot equals 6·23 British Imperial gallons per second; equals 538,272 gallons for one day.

1 second-foot equals 7·48 United States gallons per second; equals 646,272 gallons for one day.

1 second-foot for one year covers 1 square mile 1·131 feet or 13·572 inches deep.

1 second-foot for one year equals 31,536,000 cubic feet; equals 724 acre-feet.

1 second-foot equals about 1 acre-inch per hour.
1 second-foot for one 28-day month covers 1 square mile 1·041 inches deep.
1 second-foot for one 29-day month covers 1 square mile 1·079 inches deep.
1 second-foot for one 30-day month covers 1 square mile 1·116 inches deep.
1 second-foot for one 31-day month covers 1 square mile 1·153 inches deep.
1 second-foot for one day equals 1·983 acre-feet.
1 second-foot for one 28-day month equals 55·54 acre-feet.
1 second-foot for one 29-day month equals 57·52 acre-feet.
1 second-foot for one 30-day month equals 59·50 acre-feet.
1 second-foot for one 31-day month equals 61·49 acre-feet.
100 British Imperial gallons per minute equals 0·268 second-foot.
100 United States gallons per minute equals 0·223 second-foot.
1,000,000 British Imperial gallons per day equals 1·86 second-feet.
1,000,000 United States gallons per day equals 1·55 second-feet.
1,000,000 British Imperial gallons equals 3·68 acre-feet.
1,000,000 United States gallons equals 3·07 acre-feet.
1,000,000 cubic feet equals 22·95 acre-feet.
1 acre-foot equals 43,560 cubic feet.
1 acre-foot equals 271,472 British Imperial gallons.
1 acre-foot equals 325,850 United States gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0·0737 second-foot per year.
1 acre equals 43,560 square feet.
1 cubic foot equals 6·23 British Imperial gallons.
1 cubic foot equals 7·48 United States gallons.
1 cubic foot of water weighs 62·5 pounds.
1 foot per second equals 0·682 miles per hour.
1 horse-power equals 550 foot pounds per second.
1 horse-power equals 746 watts.
1 horse-power equals 1 second-foot falling 8·80 feet.

To calculate water-power quickly: *Sec.-ft.* × *fall in feet* ÷ 11 = net horse-power on water wheel, realizing 80 per cent of theoretical power.

ACCURACY AND RELIABILITY OF DATA.

The accuracy of stream-flow data depends primarily on the natural conditions at the gauging station, and on the methods and care with which the data are collected. Errors of the first group depend on the degree of permanency of channel and of permanency of the relation between discharge and stage.

Errors of the second class are due: First, to errors in observation of stage; second, to errors in measurements of flow; and, third, to errors due to misinterpretation of stage and flow data.

Practically all discharge measurements made under fair conditions are within 5 per cent of the discharge at the time of observation. Inasmuch as the errors of meter measurements are largely compensating, the mean rating curve, when well-defined, is much more accurate than the individual measurements.

In order to give information regarding the probable accuracy of the computed results, an accuracy column is added, as follows: Accuracy "A" indicated that the mean accuracy is within 5 per cent; "B", within 10 per cent; "C" within 15 per cent; and "D," within 25 per cent. Special conditions are covered by foot notes.

CO-OPERATION AND ACKNOWLEDGMENTS.

When the Railway Belt Hydrographic Survey was being organized, valuable advice and assistance was received from members of the United States Geological Survey, particularly Mr. M. O. Leighton, chief hydrographer; Mr. R. H. Bolster,

his assistant; Mr. Robert Follansbee and Mr. W. G. Hoyt, district engineers. It was due to the courtesy of Mr. Leighton that the service of one of the United States field hydrographers, Mr. C. R. Adams was obtained for a period of three months. Under Mr. Adams' guidance and experience the work was organized in British Columbia, and many gauging stations established.

The experience of the United States Geological Survey, in its many years study of water supply and water resources, has been profitably used by us, not only in our methods of field work and office computations, but we have freely used the same conclusions and opinion found in their valuable water supply papers and other publications

Thanks also are due Mr. G. R. G. Conway, of the Vancouver Power Company, and Mr. R. F. Hayward, of the Western Canada Power Company, Vancouver, for their sympathy and co-operation in our hydrographic studies of power streams near the coast.

Certain stream flow records of Jamieson creek were obtained from Mr. A. Meighen, C. E., engineer of the British Columbia Fruitlands Co., Kamloops; and the records of gauge heights on Columbia river at Golden were secured through the Columbia River Lumber Company.

For a complete discussion on the methods of hydrographic surveys, the measurements of stream flow, instruments and equipment, field methods, office methods, discussion and use of data, etc., reference should be made to that admirable text-book and manual, "River Discharge," by Hoyt and Grover (John Wiley and Sons) 2nd edition.

The Hydrographic Survey wishes to give due credit to all from whom co-operation or data have been received. At the same time, the Survey does not assume any responsibility for inaccuracies found in such data, although it is believed that most of them are reasonably accurate.

ARRANGEMENT AND ORDERS OF DATA.

It is the usual custom to arrange hydrographic data of stream flow according to drainage areas. This method was at first attempted, but it was found not to work satisfactorily in a peculiar district such as the Railway Belt. The Belt is a long narrow strip of territory of which north and south boundaries are defined by the location of the main line of the Canadian Pacific railway through British Columbia. A large portion of the upper Columbia, Thompson and Fraser drainages are, it is true, to be found in the Railway Belt, but on the whole, the watersheds of nearly all important streams are only partly in the Belt. When an attempt was made to arrange the streams according to primary, secondary and tertiary drainage areas, chaos seemed to be the result. It has been deemed advisable, therefore, to place all streams in alphabetical order, and it is hoped that, with the help of the accompanying map, and the suggestive system of station numbers, reference to any particular stream, drainage or district will be made comparatively easy.

NUMBERING OF GAUGING STATIONS.

Each hydrographic or river station is given a separate number, by which it is known. As has been said, the Railway Belt has been divided for convenience into four districts, Nos. 1, 2, 3 and 4. Each station is given a number, the first integer of which signifies the number of the district in which it is situated. For example, Station No. 119 is the river station on Coquihalla river, being the 19th station in District No. 1. Station 215, is Bonaparte river, which is the 15th station in district No. 2, or the Dry Belt; and so on.

On account of the peculiar nature of the Railway Belt, which is a long narrow strip of territory, it has been almost impossible to arrange the stations, or to number

them, in the usual manner according to drainage areas. It is believed that an alphabetical arrangement of stations, with the suggestive system of numbers, and the map showing their location, will best meet the peculiarities of the Railway Belt.

LIST OF REGULAR GAUGING STATIONS.

NOTE.—Stations marked with an asterisk (*) have been only recently established and sufficient measurements of discharge have not been taken to deduce a curve and daily discharges. Gauge readings are being systematically recorded. Each station is followed by its respective station number.

Adams River(301).
*Akolkolex river (408).
Anderson River (130), abandoned 1912.
Barnes Creek (245).
*Belknap Creek (106).
Blaeberry River (409).
Bolean Creek (306).
Bonaparte River (215).
Botanie Creek (205).
*Boulder Creek (126).
*Brandt Creek (107).
Bugaboo Creek (419).
Cache Creek (220).
Cahilty Creek (244).
Campbell Creek, at Todds Corners (250).
Campbell Creek, above Campbell Estate diversion (251).
Canoe Creek (310).
*Canyon Creek (423).
Chartrand Creek (259).
Chase Creek (260).
Chehalis River (117).
Cherry Creek (225).
Chilliwack River (110).
Columbia River, at Revelstoke (401).
Columbia River, at Golden (402).
Columbia River, at Spillimacheen (403).
Columbia River, at Athalmer (404).
Coquihalla River (119).
*Coquitlam River (upper), (123).
Cornwall Creek (209).
Criss Creek (224).
Dairy Creek (229).
Deadman River, above Walhachin Flume intake (221).
Deadman River, in Walhachin flume (222).
Deadman River, below Walhachin flume intake, abandoned 1912 (223).
*Duffy Creek (228).
Eagle River (312).
Edward's Creek, upper station (240) abandoned 1912.
Edwards Creek, at Devick's upper ranch (241)
Essell Creek (307).
Fortunes Creek (309).
Fraser River, at Lytton (102).
Fraser River, at Hope (101).
Gilley Creek (112).
*Gold Creek (122).
Greenstone Creek (261).
Guichon Creek, above Mamit lake (214).
Guichon Creek, at mouth (213).
Hat Creek, at Colley's ranch (216).
Hat Creek, in Hammond's ditch (217).
Hat Creek, at Hat Creek ranch (218).
Hat Creek, at Hat Creek ranch (lower station), (269) abandoned 1911.
Hefferly Creek, at mouth (236).
Hefferly Creek, upper station (237).
Hefferly Creek, in Anderson's ditch (238).
Hefferly Creek, in Crawshaw's ditch (239).
*Hixon Creek (105).
Horsethief Creek (421).
Illecillewaet River (406).
*Incomappleux River (407).
Ingram Creek (308).
Jacko Creek (231).
Jamieson Creek, above B.C.F. diversion (232).
Jamieson Creek, below B.C.F. diversion (233).
Jones Lake (125).
Jordan River (405).
Kicking Horse River, at Golden (410).
Kicking Horse River, at Field (411).
Kicking Horse River, at No. 2 tunnel (412).
Lillooet River, South (132).
Lillooet River, North (133).
Louis Creek (243).
Martin Creek(256), abandoned 1911.
Meadow Creek (257).
Mesliloet River, at mouth (103).
*Mesliloet River, upper station (104).
Monte Creek, Summit Lake diversion (254).
Monte Creek, below Summit Lake diversion (253).
Monte Creek, above Bostock diversion (252).
Moulton Creek (247).
Murray Creek (263).
Nahatlatch River, below Nahatlatch lakes (127).
*Nahatlatch River, lower station (128)
Neds Creek (255).
Nelson Creek (246).
Nicola River, near mouth (210).
Nicola River, at Merritt (211).
Niskonlith Creek (249).
*Norton Creek (108).
No. 2 Creek (420).
Oregon Jack Creek (208).
Ottertail River (413).
Paul Creek, above Pinantan lake (234), abandoned, 1912.
*Paul Creek, below Pinantan lake (268).
Paul Creek, below Paul lake (235).
Pemberton Creek (248).
Pendleton Creek (227).
Pollard Creek (116).
Rainbow Creek (114).
Robbins Creek (264).
*Rushton Creek (115).
Salmon River, at Woods' ranch (302).
Salmon River, at Slahaltkan (303).
Salmon River, at Salmon Arm (304).
Scottie Creek (219).
Shuswap River (311).
Silver Hope Creek (left branch), (120).
Silver Hope Creek (right branch), (121).
*Silver Pitt Creek (113).
Spillimacheon River (418).
Spius Creek (212).
Stave River (129).
Stein Creek (131).
Sullivan Creek (242).

Sweltzer Creek (111).
Thompson River, South Thompson at Chase (201).
*Thompson River, North Thompson at Cooney's ranch (203).
Thompson River, at Kamloops (202).
Thompson River, at Spence's Bridge (204).
Toby Creek (422).
Tranquille River (230).
Twaal Creek (206), abandoned 1911.
Venables Creek (207).
*Viola Creek (124).
Warren Creek (305).
Witch Creek (258).
Yoho River (415).
*Young Creek (109).

LIST OF MISCELLANEOUS GAUGING STATIONS.

NOTE.—Each station is followed by its respective station number.

Alkali Creek (226).
Bear Creek (313).
Beard Creek (423).
Blue Earth Creek (262).
Cartwright Creek (424).
Colley Creek (271).
Emerald River (414).
Gordon Creek (266).
Hogranch Creek (425).
Horse Creek (416).
Kicking Horse River, at Palliser (426).
King Creek (272).
Lane Creek 267).
Lloyd Creek (273).
Maiden Creek (265).
Nelson Creek (427).
Nikaia Creek (134).
Palmer's Creek (314).
Peterson Creek (274).
Quenville Creek (270).
Statlu Creek (118).
Three-Mile Creek.
Twenty-eight Mile Creek (428).
Washout Creek (417).

HYDROGRAPHIC DATA OF STREAM FLOW.

Adams River (301).

Adams river has its source in Adams lake at an elevation of 1,340 feet and, flowing in a southerly direction, discharges into Shuswap lake near the town of Chase at an elevation of 1,153 feet. The following tributaries enter from the west: Bear creek, Bush creek, Pass creek, and Upper Adams river; Nikwikwaia creek enters from the east. Adams river is a part of the Shuswap lake-Thompson drainage. The drainage area, as measured from a provincial map, scale 20 miles to 1 inch, is 1,700 square miles; of this area Adams lake constitutes 60 square miles. The water is used extensively for logging by the Adams River Lumber Company.

The Upper Adams river rises in Tum-tum lake, about 80 miles north of the main line of the C.P.R., near Chase. From this lake it flows in a southerly direction for about 40 miles into Adams lake, a magnificent sheet of water, 40 miles long, a mile and a half wide, surrounded by high mountains. The lake rises 4 to 5 feet above its low-water level, high water taking place in June. There is some agricultural land around the lake, but it is sparsely settled, and if it were desirable to use the lake as a storage reservoir for water-power purposes, and retain the lake at its high-water level, no important interests would be affected. At its southerly end Adams lake empties into Adams river, where it falls 190 feet into Shuswap lake in the short distance of 6 miles.

There are large areas of valuable timber along Adams lake, and its several tributaries. The Adams River Lumber Company is the largest operating company; this company has constructed a dam on Adams river, about one-quarter of a mile from the outlet of the lake, for log-driving purposes. The dam is rock-filled, timber-cribbed, about 180 feet long and 15 feet high; it has six sluice-gates, and a fish ladder. On account of the excellent storage of Adams lake, it will be easy to conserve the greater part, if not all, of the run-off from season to season. The total discharge of 1912 will give a good daily mean for that period; the year 1912, however, is above the normal in run-off in this locality, and so should not be taken as representative of an average year.

The Adams River station was established June 31, 1911, by C. E. Richardson. The measuring section is located 250 yards above the Adams River Lumber Company's

dam, and 25 yards above the old wing dam. The gauge is a vertical staff gauge (fir), 2 inches by 4 inches by 8 feet marked in feet and tenths with black paint, fastened to a rock-filled crib 7 feet high, situated in a back-eddy on the right bank, 75 yards below the dam, and built to protect the gauge from logs and ice. The measurements are made by means of the following equipment. A ⅜-inch mild steel cable is stretched across the river; 20 feet downstream a tag line of ½-inch mild steel cable is stretched across and pulled taut, a boat is fastened by rope to the larger cable, and allowed to rest directly below the tag line; measurements are made every 20 feet.

This is an excellent measuring section; there is only one channel, with a permanent bed; the banks are good, and the current is even. The datum of the gauge is referred to three bench-marks.

Adams river is one of the best undeveloped powers in the interior of British Columbia. Fully 30,000 to 40,000 horse-power could be developed by utilizing the full head of 190 feet. This would be an expensive installation, however, and it might be economically advisable to use only the upper site of about 68 feet.

The power could be transmitted to Kamloops, Chase, Salmon Arm, Sicamous, Armstrong, Enderbey and Vernon, and would be of tremendous importance for pumping water from Thompson river to irrigate thousands of acres of now useless lands along the Thompson valley.

Discharge Measurements of Adams River, below Adams Lake, in 1911.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
1911 July 7	C. E. Richardson	1048	450	2,780	2·1	4·4	5,900
Nov. 8	C. E. R. and W. M. C.	1055	330	1,770	0·3	0·57	484*
" 9	" "	1055	350	1,700	0·4	0·9	602*
" 9	" "	1055	350	1,720	1·2	2·6	1,960*
" 10	" "	1055	430	1,700	1·9	3·4	3,160*
" 11	" "	1055	410	1,670	0·7	1·7	1,180*
Dec. 12	C. E. Richardson	1055	100	96	1·4	−0·3	130†

* Measurement made from boat above dam. † Measurement made by wading below dam.

Adams River Lumber Company's Dam.

Adams River Lumber Company's Dam.

DAILY GAUGE HEIGHT AND DISCHARGE OF ADAMS RIVER BELOW ADAMS LAKE, FOR 1911.

Day.	JULY.		AUGUST.		NOVEMBER.		DECEMBER.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	5,610	3·2	2,870	.....	.....	−0·3	135
2	4·3	5,610	3·2	2,870	.....	.....	−0·3	135
3	4·4	5,900	3·2	2,870	.....	.....	−0·3	135
4	4·5	6,200	3·2	2,870	.....	.....	−0·3	135
5	4·4	5,900	3·2	2,870	.....	.....	−0·3	135
6	4·4	5,900	3·2	2,870	.....	.....	−0·3	135
7	4·4	5,900	3·2	2,870	.....	.....	−0·3	135
8	4·4	5,900	3·2	2,870	.....	.....	−0·3	135
9	4·5	6,200	3·2	2,870	.....	.....	−0·3	135
10	4·6	6,500	.....	.....	.....	.....	−0·3	135
11	4·3	5,610	.....	.....	1·7	1,060	−0·3	135
12	4·3	5,610	.....	.....	1·7	1,060	−0·33	130
13	4·1	5,030	.....	.....	1·7	1,060	−0·3	135
14	3·9	4,480	.....	.....	1·7	1,060	−0·3	135
15	3·9	4,480	.....	.....	2·8	2,205	−0·3	135
16	4·6	6,500	.....	.....	3·0	2,510	−0·32	133
17	4·6	6,500	.....	.....	2·8	2,205	−0·32	133
18	4·6	6,500	.....	.....	2·8	2,205	−0·32	133
19	4·2	5,320	.....	.....	2·7	2,067	−0·32	133
20	4·1	5,030	.....	.....	2·6	1,935	−0·32	133
21	3·8	4,220	.....	.....	2·6	1,935	−0·32	133
22	3·6	3,730	.....	.....	2·5	1,810	−0·32	133
23	3·6	3,730	.....	.....	−0·3	135	−0·32	133
24	3·4	3,280	.....	.....	−0·3	135	−0,32	133
25	3·6	3,730	.....	.....	−0·3	135	−0·32	133
26	3·5	3,500	.....	.....	−0·3	135	−0·32	133
27	3·6	3,730	.....	.....	−0·3	135	−0·32	133
28	3·5	3,500	.....	.....	−0·3	135	−0·32	133
29	3·5	3,500	.....	.....	−0·3	135	−0·3	135
30	3·3	3,070	.....	.....	−0·3	135	−0·3	135
31	3·7	3,970	.....	.....	−0·3	135	−0·3	135

MONTHLY DISCHARGE OF ADAMS RIVER BELOW ADAMS LAKE, FOR 1911.

(Drainage area, 1,700 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per square mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
July	6,500	3,070	4,988	2.93	3.38	306,800	.....
December	135	130	134	·08	·09	8,239	.....
The period	.....	.....	.....	.....	.....	.....	30

NOTE.—Gauge was washed out early in August, and was not replaced until November.

Open flow conditions exist throughout the winter months at this station.

Discharge is artificially controlled by Adams River Lumber Co.'s dam. The maximum discharge was obtained with all six gates open and the lake at about its highest level. It is not necessarily the true maximum discharge of the river.

The minimum discharge was obtained with all six gates of the dam closed and the fishway only open. It is not necessarily the true minimum.

Accuracy—"A."

DAILY GAUGE HEIGHT AND DISCHARGE OF ADAMS RIVER BELOW ADAMS LAKE FOR 1912.

Day.	January.		February.		March.		April.		May.		June.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	−0·3	135	−0·33	127	2·1	1,380	−0·4	110	−0·5	85	5·0	7,800
2	−0·3	135	−0·33	127	2·1	1,380	−0·4	110	−0·5	85	3·6	3,730
3	−0·3	135	−0·33	127	2·1	1,380	−0·4	110	−0·5	85	3·6	3,730
4	−0·3	135	−0·33	127	1·9	1,210	−0·4	110	−0·5	85	3·6	3,730
5	−0·3	135	−0·33	127	1·7	1,060	−0·4	110	−0·5	85	−0·1	195
6	−0·3	135	−0·33	127	1·7	1,060	−0·4	110	−0·5	85	−0·1	195
7	−0·3	135	−0·33	127	1·6	995	−0·4	110	−0·5	85	3·6	3,730
8	−0·3	135	−0·33	127	1·6	995	−0·4	110	−0·5	85	3·5	3,500
9	−0·3	135	−0·33	127	1·6	995	−0·4	110	−0·4	110	3·5	3,500
10	−0·3	135	−0·33	127	1·5	930	−0·4	110	−0·4	110	3·6	3,730
11	−0·3	135	−0·33	127	1·5	930	−0·4	110	4·0	4,750	4·1	5,030
12	−0·3	135	−0·33	127	1·4	870	−0·4	110	4·0	4,750	4·1	5,030
13	−0·3	135	−0·33	127	1·4	870	−0·4	110	4·2	5,330	4·1	5,030
14	−0·3	135	−0·33	127	1·3	810	−0·4	110	4·3	5,610	4·3	5,610
15	−0·3	135	−0·33	127	1·3	810	−0·4	110	4·5	6,200	4·2	5,320
16	−0·3	135	−0·33	127	1·3	810	−0·4	110	4·6	6,500	4·2	5,320
17	3·2	2,870	−0·33	127	1·3	810	−0·4	110	4·6	6,500	4·2	5,320
18	3·2	2,870	−0·33	127	1·2	755	−0·4	110	4·6	6,500	4·2	5,320
19	2·9	2,350	−0·33	127	1·2	755	2·5	1,810	5·7	10,500	4·2	5,320
20	2·9	2,350	1·80	1,130	1·1	700	2·5	1,810	5·7	10,500	4·3	5,610
21	2·8	2,200	1·80	1,130	1·1	700	2·6	1,930	5·7	10,500	4·3	5,610
22	2·8	2,200	1·80	1,130	1·1	700	2·6	1,930	5·7	10,500	4·3	5,610
23	2·8	2,200	2·3	1,580	1·0	650	2·7	2,070	5·7	10,500	4·8	7,100
24	2·7	2,070	2·3	1,580	1·0	650	2·7	2,070	5·7	10,500	4·8	7,100
25	2·6	1,930	2·3	1,580	1·0	650	2·7	2,070	5·7	10,500	4·8	7,100
26	−0·3	135	2·3	1,580	1·0	650	2·7	2,070	5·6	10,100	4·8	7,100
27	−0·3	135	2·3	1,580	0·9	600	2·7	2,070	5·5	9,700	4·5	6,200
28	−0·3	135	2·3	1,580	0·9	600	2·7	2,070	5·4	9,300	4·5	6,200
29	−0·3	135	2·2	1,490	0·9	600	2·7	2,070	5·2	8,500	4·5	6,200
30	−0·3	135	.....	.....	0·9	600	−0·5	85	5·1	8,150	4·4	5,900
31	−0·33	127	.....	.....	0·4	110	.....	.....	5·1	8,150	4·7	.....

DAILY GAUGE HEIGHT AND DISCHARGE OF ADAMS RIVER BELOW ADAMS LAKE FOR 1912.—*Continued.*

Day.	July.		August.		September.		October.		November.		December.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	4·40	5,900	4·7	6,800	4·5	6,200	2·5	1,810	−0·1	195	−0·2	165
2	4·30	5,610	4·6	6·500	4·4	5,900	2·4	1,690	−0·1	195	−0·2	165
3	3·60	3,730	4·7	6,800	4·4	5,900	2·3	1,585	−0·1	195	−0·2	165
4	1·90	1,210	0·2	300	3·4	3,280	2·2	1,485	−0·1	195	−0·2	165
5	1·90	1,210	0·1	265	2·5	1,810	2·2	1,485	−0·1	195	−0·2	165
6	4·60	6,500	0·1	265	3·9	4,480	2·2	1,485	−0·1	195	−0·2	165
7	3·60	3,730	5·5	9,700	3·8	4,220	2·2	1,485	−0·1	195	−0·2	165
8	3·40	3,280	5·5	9,700	3·8	4·220	2·1	1,385	−0·1	195	−0·2	165
9	3·80	4,220	4·7	6,800	3·8	4,220	2·1	1,385	−0·1	195	3·0	2,510
10	4·02	4,800	0·1	265	3·7	3,970	2·1	1,385	−0·1	195	3·0	2,510
11	4·8	7,100	5·7	10,500	3·7	3,970	2·1	1,385	−0·1	195	2·9	2,350
12	4·8	7,100	5·7	10,500	3·6	3,730	2·0	1,290	1·2	755	2·9	2,350
13	4·8	7,100	0·1	265	3·6	3,730	2·0	1,290	1·2	755	2·9	2,350
14	4·85	7,275	2·7	2,070	3·5	3,500	2·0	1,290	1·2	755	2·9	2,350
15	3·1	2,680	5·5	9,700	3·4	3,280	1·9	1,210	1·2	755	2·8	2,205
16	3·2	2,870	0·1	265	3·3	3,070	1·9	1,210	1·2	755	2·8	2,205
17	3·2	2,870	5·5	9,700	3·3	3,070	1·9	1,210	1·1	702	2·8	2,205
18	5·1	8,150	5·4	9,300	3·2	2,870	1·9	1,210	1·1	702	2·7	2,067
19	5·1	8,150	5·0	7,800	3·1	2,680	1·9	1,210	1·0	650	2·7	2,067
20	3·4	3,280	4·9	7,450	3·1	2,680	1·9	1,210	1·0	650	2·6	1,935
21	4·9	7,450	4·9	7,450	3·0	2,510	1·9	1,210	0·9	600	2·6	1,935
22	3·3	3,070	4·9	7,450	3·0	2,510	−0·1	195	−0·1	195	2·5	1,810
23	5·5	9,700	4·8	7,100	2·9	2,350	−0·1	195	−0·2	165	2·5	1,810
24	4·8	7,100	4·8	7,100	2·9	2,350	−0·1	195	−0·2	165	2·4	1,694
25	4·8	7,100	0·1	265	2·8	2,200	−0·1	195	−0·2	165	2·4	1,694
26	4·8	7,100	2·7	2,070	2·8	2,200	−0·1	195	−0·2	165	2·3	1,585
27	2·1	1,385	2·7	2,070	2·7	2,070	−0·1	195	−0·2	165	−0·2	165
28	4·9	7,450	4·9	7,450	2·6	1,935	−0·1	195	−0·2	165	−0·2	165
29	4·9	7,450	4·9	7,450	2·6	1,935	−0·1	195	−0·2	165	−0·2	165
30	4·9	7,450	4·8	7,100	2·5	1,810	−0·1	195	−0·2	165	−0·2	165
31	4·7	6,800	4·7	6,800	.....	.....	−0·1	195	.....	.....	−0·2	165

MONTHLY DISCHARGE OF ADAMS RIVER, BELOW ADAMS LAKE, FOR 1912.

(Drainage area, 1,700 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per square mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
January	2,870	127	774	·46	·53	47,600	
February	1,580	127	578	·34	·37	33,250	
March	1,380	110	839	·49	·56	51,600	
April	2,070	85	801	·47	·52	47,650	
May	10,500	85	5,627	3·31	3·82	346,200	
June	7,800	195	5,029	2·96	3·30	299,300	
July	9,700	1,210	5,446	3·20	3·69	335,100	
August	10,500	265	5,718	3·36	3·87	351,700	
September	6,200	1,810	3,288	1·93	2·15	195,800	
October	1,810	195	995	·58	·67	61,200	
November	755	165	358	0·21	0·23	21,300	
December	2,510	165	1,283	0·75	0·86	78,700	
The year	10,500	85	2,561	1·50	20·57	1,869,400	30

NOTE.—See notes on 1911 monthly discharge sheet.
The mean flow for 1912 was 2,561 c.f.s.
Accuracy, "A."

ALKALI CREEK (226).

Alkali creek is a small irrigation stream about five miles long in the centre of the 'Dry Belt'; it has its source in the hills south of Kamloops at an elevation of 4,000 feet and flows into Cherry creek in section 34, township 19 at an elevation of 2,500 feet. The drainage area, as measured from the Geological Survey map, dated 1895, scale 2 miles to an inch, is 13 square miles, and belongs to the Cherry South Thompson drainage.

The mean annual precipitation is about 10 inches, the summers are hot and dry and the winters long and very cold (-30° F.); the stream only runs during the spring of the year, and was entirely dry during 1911.

There are two small lakes, about 10 acres in area, which have small storage dams 4 feet in height; on one of these lakes—an unnamed lake two miles from the source—a higher dam would be feasible, though it is doubtful whether the freshet in a normal year would be sufficient to fill the enlarged reservoir. The other lake—Hughes lake—is about half a mile from the mouth of Alkali creek.

In the spring of 1912, a small temporary gauge was established and several measurements were taken.

ANDERSON RIVER (130).

Anderson river rises in the Anderson hills at an elevation of 6,000 feet and discharges into the Fraser river in township 10, range 26 west 6th meridian at an altitude of 500 feet, having a drainage area of 200 square miles. The water is at present unused, though there are small power possibilities at the mouth of the stream.

The main branch of Anderson river rises close to the Fraser river, and flows north, for ten miles or more, within five miles of the Fraser. Uztlius river, the most important tributary of Anderson river, rises near the head-waters of Spius creek, and flows in a westerly direction to meet the Anderson. There is a deep canyon near the mouth of the Anderson river which extends up stream for many miles; at the canyon's

mouth there is a large bar of sand and gravel which, exposed at low water, is covered by the waters of the Fraser at its high stages. This is known as Boston bar, and there were more than a thousand men upon it in the days of gold panning on the Fraser river.

There is an Indian reserve on the south side of the Anderson river which contains the only land being cultivated in the watershed. The only means of communication in the valley is a pack trail which climbs from the Fraser valley to the top of the canyon crossing the Uztlius river and the divide to Spius creek, passing thence to the Nicola country. The country is very rough with several peaks rising to an altitude of 6,000 feet; the hillsides are steep and most of the watershed is well wooded.

The station is at the mouth of the canyon, 4 miles from the North Bend ferry, where the banks are high, rocky and wooded, and the river is confined to one channel. It was established by C. G. Cline, on April 9, 1912, gauge readings being taken continuously till September 30, 1912. Measurements are made by wading at low water and from a canoe attached to a cable at high water.

The gauge itself is a chain gauge, being of No. 16 double link jack chain, 24.0 feet long with a 24 pound sash weight. There is a danger that at extremely high stages of the Fraser the backwater from it may affect the gauge readings.

DISCHARGE MEASUREMENTS of Anderson River, near Mouth, 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
April 9.....	C. G. Cline	1046	80	141	2·3	2·8	322
July 16.....	"	1046	73	128	1·3	2·0	166
Sept. 27.....	"	1046	60	127	0·6	1·6	76

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Daily Gauge Height and Discharge of Anderson River, near Mouth, for 1912.

Day.	April.		May.		June.		July.		August.		September.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	326	3·1	396	3·5	495	2·8	326	1·6	80	1·9	136
2	.....	326	3·1	396	3·2	420	2·7	303	1·6	80	1·9	136
3	.....	326	3·2	420	3·0	373	2·5	259	1·6	80	1·9	136
4	.....	326	3·3	445	3·1	396	2·4	237	1·6	82	1·8	117
5	.....	326	3·2	420	3·2	420	2·2	195	1·6	80	1·8	117
6	.....	326	3·3	445	3·4	470	2·1	175	1·5	63	1·8	117
7	.....	326	3·8	570	3·2	420	2·2	195	1·6	80	1·7	98
8	.....	326	4·4	720	3·4	470	2·2	195	1·7	98	1·7	98
9	.....	326	4·0	620	3·3	445	2·3	215	1·7	98	1·7	98
10	.....	326	3·8	570	3·2	420	2·4	237	1·7	98	1·6	80
11	.....	326	3·8	570	3·3	445	2·4	237	1·6	80	1·6	80
12	.....	326	3·9	595	3·1	396	2·3	215	1·7	98	1·7	98
13	.....	326	4·1	645	3·0	373	2·2	195	1·8	117	1·7	98
14	2·8	326	4·3	695	2·9	350	2·1	175	1·9	136	1·8	117
15	2·8	326	4·6	780	2·8	326	2·0	155	2·0	155	1·9	136
16	2·8	326	4·8	835	2·7	303	1·9	136	2·1	175	1·9	136
17	2·8	326	4·4	720	.....	303	1·8	117	2·2	195	1·8	80
18	2·8	326	4·0	620	.....	303	1·8	117	2·3	215	1·7	98
19	2·9	350	3·6	520	.....	303	1·7	98	2·3	215	1·7	98
20	2·9	350	3·8	570	.....	303	1·6	80	2·2	195	1·8	117
21	2·8	326	3·9	595	.....	303	1·7	98	2·2	195	1·8	117
22	2·8	326	4·1	645	.....	303	1·6	80	2·2	195	1·8	117
23	2·9	350	4·2	670	.....	303	1·7	98	2·2	195	1·7	98
24	2·9	350	4·1	645	.....	326	1·6	80	2·2	195	1·7	98
25	2·8	326	3·9	595	.....	326	1·6	80	2·2	195	1·6	80
26	2·8	326	4·0	620	.....	326	1·6	80	2·1	175	1·6	80
27	2·9	350	4·2	670	.....	326	1·6	80	2·1	175	1·7	98
28	2·9	350	3·9	595	.....	326	1·6	80	2·1	175	1·7	98
29	2·9	350	3·9	595	.....	326	1·6	80	2·0	155	1·7	98
30	3·0	373	3·6	520	.....	326	1·6	80	2·0	155	1·7	98
31	.....	.....	3·7	545	.....	.....	1·6	80	2·0	155	.....	.....

Monthly Discharge of Anderson River, near Mouth, for 1912.

(Drainage area, 200 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	373	326	333	1·7	1·9	19,800	
May	835	396	589	2·9	3·3	36,200	
June	495	303	364	1·8	2·0	21,700	
July	326	80	154	0·77	0·89	9,470	
August	215	63	141	0·70	0·80	8,670	
September	136	80	106	0·53	0·59	6,300	
The period							50

Note.—Gauge readings were discontinued on September 30, 1912.
Accuracy, "A" and "C."

Barnes Creek (245).

Barnes creek (sometimes called Pennies or Penny's creek) is about 12 miles long and lies in the Dry Belt; it rises in the hills east of Ashcroft at an elevation of 4,000 feet, and discharges into the Thompson river from the south, about four miles east of Ashcroft, at an elevation of 960 feet; the drainage area above the mouth is 38 square miles and above the gauging station about 35 square miles.

Barnes creek is a contentious stream, its waters being used for irrigation, and nearly drying up during July and August, the mean annual precipitation being but 9 inches, and the summers hot and dry; the winters are cold and dry.

The stream is about 12 feet wide and varies in depth from 0·5 to 1·7 feet between low and high water; its mean velocity at high water is 3·5 feet per second.

The discharge fluctuates from practically zero in the winter to a maximum of about 50 or 60 cubic feet per second in the spring freshet during the middle of May; it then declines rapidly, becoming as low as from 3 to 4 second-feet about July 1, remaining at that figure all through that month. In the fall it rises for a short time, then recedes as the cold weather comes on.

Water is diverted from Barnes creek near the head-waters and stored in the Twin lakes for use near Walhachin. There is also a diversion to Barnes lake, from which the water may be returned to Barnes creek for use farther down the stream, or it may be run into Nelson creek for use in that direction. Usually there is a shortage of water on Barnes creek, though in 1912 Barnes lake filled and overflowed, the water users being forced to ask that water be diverted to the Twin lakes, although they had previously taken out an injunction against that diversion.

The gauging station on Barnes creek is 200 yards above Barnes lake and five miles southeast of Ashcroft, B.C.; it was established April 26, 1912, by C. G. Cline. The gauge, which is a 5-foot staff gauge nailed to a small tree on the right bank of the creek, is situated 150 feet above the first highway bridge over the main stream above Barnes lake, and daily gauge readings were taken until the end of the irrigation season. The measurements were made by wading at the downstream side of the bridge. The stream is straight for about 100 feet above the measuring section, and for 50 feet below it, and the water swift. The road has been built up to form the approaches to the bridge, and there is no danger of overflow. There is only one channel, which is about 6 inches deep at ordinary low water. The riffle just below the gauge should be examined occasionally to see that brush and logs do not collect on it and so back the water up on the gauge. This station gives the whole flow of the stream except what is diverted into the Twin lakes near the head-waters of the stream by the British Columbia Horticultural Estates at Walhachin.

Discharge Measurements of Barnes Creek, above Barnes Lake, 1912.

Date	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
April 26...	C. G. Cline	1046	12	5·7	1·3	0·57	7·4
May 11....	"	1046	12	13·4	3·3	1·0	44·6
June 21....	Cline & Corbould	1046	4·5	2·4	1·6	·43	3·8
July 8....	B. Corbould	1044	9·5	9·1	2·5	0·75	22·9
July 27....	"	1044	9·5	6·2	1·8	0·6	10·9
Aug. 17....	"	1044	9·5	5·7	1·4	0·51	8·2

DAILY GAUGE HEIGHT AND DISCHARGE of Barnes Creek, above Barnes Lake for 1912.

Day.	April.		May.		June.		July.		August.		September.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec-ft.	Feet.	Sec-ft.	Feet.	Sec-ft.	Feet.	Sec-ft.	Feet.	Sec-ft.	Feet.	Sec-ft.
1			0·75	23	0·6	12	0·55	9·3	0·55	9·3	0·5	6·6
2			0·8	27	0·55	9·3	0·6	12	0·55	9·3	0·5	6·6
3			0·85	31	0·5	6·6	0·6	12	0·55	9·3	0·5	6·6
4			0·85	31	0·5	6·6	0·65	15·5	0·6	12	0·5	6·6
5			0·9	36	0·45	4·7	0·7	19	0·6	12	0·45	4·7
6			0·95	40	0·45	4·7	0·7	19	0·55	9·3	0·45	4·7
7			1·0	45	0·4	2·7	0·75	23	0·5	6·6	0·4	2·7
8			1·1	54	0·4	2·7	0·75	23	0·5	6·6	0·4	2·7
9			1·25	68	0·45	4·7	0·7	19	0·5	6·6	0·4	2·7
10			1·05	50	0·5	6·6	0·7	19	0·5	6·6	0·4	2·7
11			1·1	54	0·5	6·6	0·75	23	0·5	6·6	0·4	2·7
12			1·2	63	0·45	4·7	0·7	19	0·5	6·6	0·4	2·7
13			1·3	73	0·45	4·7	0·7	19	0·55	9·3	0·35	1·3
14			1·65	108	0·5	6·6	0·65	15·5	0·55	9·3	0·35	1·3
15			1·5	93	0·55	9·3	0·6	12	0·55	9·3		
16			1·45	88	0·5	6·6	0·55	9·3	0·55	9·3		
17			1·35	78	0·45	4·7	0·5	6·6	0·6	12		
18			1·3	73	0·4	2·7	0·5	6·6	0·6	12		
19			1·25	68	0·4	2·7	0·45	4·7	0·6	12		
20			1·3	73	0·45	4·7	0·45	4·7	0·55	9·3		
21			1·25	68	0·5	6·6	0·5	6·6	0·55	9·3		
22			1·35	78	0·55	9·3	0·55	9·3	0·5	6·6		
23			1·25	68	0·5	6·6	0·55	9·3	0·5	6·6		
24			1·1	54	0·45	4·7	0·6	12	0·4	2·7		
25			1·05	50	0·45	4·7	0·7	19	0·4	2·7		
26	0·55	9·3	1·0	45	0·4	2·7	0·7	19	0·4	2·7		
27	0·6	12·0	0·95	40	0·4	2·7	0·6	12	0·4	2·7		
28	0·65	15·5	0·9	36	0·45	4·7	0·65	15·5	0·4	2·7		
29	0·75	23·0	0·85	31	0·5	6·6	0·65	15·5	0·45	4·7		
30	0·75	23·0	0·75	23	0·55	9·5	0·6	12	0·45	4·7		
31			0·7	19			0·6	12	0·45	4·7		

MONTHLY DISCHARGE of Barnes Creek, above Barnes Lake, for 1912.

(Drainage area, 35 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Persquare mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	108	19	54·5	1·6	1·8	3,350	
June	12	2·7	5·7	0·16	0·18	340	
July	23	4·7	14	0·4	0·5	860	
August	12	2·7	7·5	0·21	0·24	461	
The period							10

NOTE.—Barnes Creek Station is maintained during irrigation season only. Winter conditions exist from December to April 1st.

Accuracy, "A" and "C."

Blaeberry River (409).

Blaeberry river rises near the Freshfield group of mountains in Howse pass, near the summit of the Rocky mountains, at an elevation of 4,800 feet, and discharges into Columbia river near Moberly (11 miles northwest of Golden) at an elevation of 2,550 feet. Its drainage area is 325 square miles, and above the falls, a possible site for a small power development, 300 square miles, the water is unused at present, but will probably be utilized for lumbering purposes as well as for power enterprises. Precipitation in the valley varies from 30 inches to 90 inches, and winter conditions are very severe, the river being usually frozen over by the first week in December and not free from ice until the first week in April; in February, 1912, the ice at the mouth of the river was two feet thick and was covered with two feet of snow.

Blaeberry river is between forty and fifty miles long, and is glacial fed; from Mummery glacier alone the Blaeberry receives one-quarter of its water. The Blaeberry valley for about 6 or 8 miles from its mouth is about one mile wide, containing some fair agricultural land not yet taken up. The Canadian Pacific Railway crosses the river about one mile from its mouth, and below the railway the river flows over shifting gravel bars.

Blaeberry river is generally swift, and is not navigable for boats. At the Canadian Pacific Railway bridge, where the Hydrographic Survey station is located, the river is about 50 feet wide and about 3 feet deep at low water, having a mean velocity of 0·4 feet per second; at high water it is 80 feet wide, 6·5 feet deep and has a velocity of nearly 8 feet per second.

There is much valuable timber in the Blaeberry valley—both within and outside the Railway Belt—spruce, fir, cedar and hemlock; none of this timber has been cut, although most of it has been taken up.

There is no cultivation or development of any kind in the valley. About 8 miles from the railway there is a canyon with steep rocky banks from 35 to 50 feet high, the river being from 15 to 30 feet wide; this canyon is about 2 miles long and the river falls 135 feet therein (measured by aneroid). At the head of the canyon, where the river is only 15 feet wide, there is a sheer fall of 20 feet, and between the canyon and the railway, a distance of 8 miles, there is a fall of 350 feet.

Above the falls the river broadens, in some places flowing over gravel bars with numerous side channels; the banks are low, and there are no good natural storage lakes or reservoirs.

The station was established on October 16, 1911, by C. E. Richardson, and was discontinued when ice conditions commenced to prevail on November 8 of that year; in 1912 records were taken from break-up, early in April, to freeze-up, early in November. The Canadian Pacific Railway bridge, three-quarters of a mile from the mouth, is used for taking measurements, while the gauge, a vertical staff gauge 6 feet by 2 inches by 4 inches, graduated in feet and tenths with markings in black paint, is located on the left bank of the stream, fastened to a rock-fill crib in a pool 50 feet below the bridge. The water is well confined to one channel, the bridge abutments constituting the banks of the stream at the measuring section during high water; at low water the stream recedes from the abutments, and borders on the rocks. In high water the channel continually shifts, although riffles just above and below give good control at the station. Three bench-marks have been placed and referred to the gauge datum.

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DISCHARGE MEASUREMENTS of Blaeberry River, at C.P.R. Bridge (one mile from mouth), for 1911.

Date	Hydrographer.	Meter	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
1911.							
Oct. 16	C. E. Richardson	1048	68	177	1·75	0·9	310
1912.							
Feb. 21	"	1047	51	148	0·4		*535
June 6	H. C. Hughes	1055	70	199	2·4	1·4	484
June 7	"	1055	78	237	3·1	1·90	746
June 25	"	1055	86	398	7·3	3·5	2,896
July 11	"	1055	80	293	4·5	2·7	1,327
July 27	"	1055	80	279	4·1	2·43	1,141
Oct. 3	C. E. Richardson	1055	70	215	2·4	1·4	512

*Under ice-cover.

DAILY GAUGE HEIGHT AND DISCHARGE of Blaeberry River at C.P.R. Bridge, for 1911.

Day.	October.		November.	
	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·5	210
2				210
3			0·5	210
4				220
5			0·6	230
6				220
7			0·5	210
8			Freeze up.	
9				
10				
11				
12				
13				
14				
15				
16	0·9	310		
17		300		
18	0·8	280		
19		260		
20	0·6	230		
21		210		
22	0·4	190		
23		170		
24	0·2	150		
25	0·3	170		
26		170		
27		170		
28		170		
29	0·3	170		
30		180		
31	0·4	190		

Daily Gauge Height and Discharge of

Day.	April.		May.		June.		July.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	.....	0·9	310	1·7	630	2·7	1,340
2	.....	.....	1·1	370	.....	580	.....	1,340
3	.....	.....	1·15	390	.....	530	2·7	1,340
4	.....	.....	1·2	410	1·4	490	.....	1,300
5	.....	.....	1·2	410	.....	490	.....	1,290
6	.....	.....	1·2	410	1·4	490	2·6	1,250
7	.....	.....	1·2	410	.....	700	.....	1,210
8	.....	.....	1·2	410	.....	900	.....	1,200
9	.....	.....	1·3	450	.....	1,100	2·5	1,160
10	.....	.....	1·4	490	2·7	1,340	.....	1,360
11	.....	.....	2·3	1,000	.....	1,390	2·9	1,570
12	.....	.....	2·35	1,040	2·8	1,440	.....	1,500
13	.....	.....	2·4	1,080	.....	1,720	2·8	1,440
14	.....	.....	2·43	1,100	3·2	2,100	.....	1,440
15	0·9	310	2·46	1,130	3·2	2,100	.....	1,440
16	0·9	310	2·5	1,160	.....	2,100	2·8	1,440
17	0·9	310	2·4	1,080	3·2	2,100	.....	1,390
18	0·95	325	2·3	1,000	.....	2,330	2·7	1,340
19	1·0	340	2·15	895	3·4	2,580	.....	1,300
20	0·87	304	2·0	800	.....	2,890	2·6	1,250
21	0·75	265	2·15	895	.....	3,320	.....	1,340
22	0·6	230	2·3	1,000	3·7	4,000	.....	1,440
23	0·5	210	2·25	965	.....	3,600	2·9	1,570
24	0·4	190	2·2	930	.....	3,300	.....	1,500
25	0·35	180	2·17	910	3·5	2,890	2·8	1,440
26	0·35	180	2·13	880	.....	2,580	.....	1,300
27	0·3	170	2·1	860	3·3	2,330	2·5	1,160
28	0·3	170	2·05	830	.....	1,900		1,200
29	0·3	170	2·0	800	2·8	1,440	2·6	1,250
30	0·5	210	1·9	740	.....	1,400	.....	1,300
31	.....	.....	1·8	680	.....	.....	2·7	1,340

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Blaeberry River, at C.P.R. Bridge, for 1912.

August.		September.		October.		November.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
.....	1,390	2·3	1,000	1·3	450	.....	320	1
2·8	1,440	.....	990	.....	450	.....	300	2
.....	1,600	.....	960	.....	450	0·8	280	3
.....	1,800	.....	940	1·3	450	.....	265	4
3·1	1,900	2·2	930	1·4	490	0·7	250	5
.....	1,800	.....	860	.....	510	.....	260	6
.....	1,500	2·0	800	1·5	530	.....	270	7
2·8	1,440	.....	830	.....	490	0·8	280	8
.....	1,510	2·1	860	.....	490	.....	295	9
2·9	1,570	.....	900	1·3	450	0·9	310	10
.....	1,290	2·2	930	1·2	410	.....	325	11
2·3	1,000	.....	800	.....	390	1·0	340	12
.....	1,080	.....	770	.....	390	.....	310	13
2·5	1,160	1·9	740	1·1	370	0·8	280	14
.....	1,300	.....	800	.....	355	.....	.....	15
2·8	1,440	2·1	860	1·0	340	.....	.....	16
.....	1,390	.....	830	.....	340	.....	.....	17
2·7	1,340	2·0	800	.....	340	.....	.....	18
.....	1,440	.....	770	1·0	340	.....	.....	19
.....	1,620	1·9	740	.....	355	.....	.....	20
3·0	1,720	.....	630	1·1	370	.....	.....	21
.....	1,910	.....	580	.....	355	.....	.....	22
3·2	2,100	1·4	490	.....	355	.....	.....	23
.....	3,000	.....	490	1·0	340	.....	.....	24
.....	3,600	1·4	490	.....	340	.....	.....	25
3·6	3,320	.....	490	1·0	340	.....	.....	26
.....	2,360	.....	450	.....	325	.....	.....	27
2·8	1,440	1·3	450	0·9	310	.....	.....	28
.....	1,300	.....	450	.....	325	.....	.....	29
.....	1,100	.....	450	1·0	340	.....	.....	30
2·2	930	.....	.....	1·0	340	.....	.....	31

MONTHLY DISCHARGE of Blaeberry River, at C.P.R. Bridge, for 1912.

(Drainage area, 325 square miles.)

Month.	Maximum	Minimum	Mean.	Per square Mile.	Depth in inches on Drainage area.	Total. in acre feet	
April	340	130	200	0·6	0·66	11,900	
May	1,160	310	770	2·36	2·7	47,300	
June	4,000	490	1,820	5·6	6·2	108,300	
July	1,570	1,160	1,350	4·2	4·8	83,000	
August	3,600	930	1,670	5·1	5·9	102,700	
September	1,000	450	736	2·3	2·6	43,800	
October	530	310	391	1·2	1·4	24,000	
The period							40

NOTE.—Ice conditions occurred November 8, 1911. River froze solid about December 25, 1911. Channel opened April 15, 1912. A discharge of 53·5 second-feet was obtained on February 21, 1912, under ice cover. This is about the minimum. Accuracy, "A."

BLUE-EARTH CREEK (262).

Blue-earth creek, a small tributary of Upper Hat creek, in township 19-26-6, rises in Blue-earth lake at an elevation of about 3,800 feet, is about 5 miles long, and discharges into Upper Hat creek from the east.

The drainage area of Blue-earth creek is about 15, and of Blue-earth lake, about 7 square miles.

The following float measurements were made of Blue-earth creek in 1911:—

May 10—Discharge, 1·4 c.f.s.
May 18— " 4·0 c.f.s. (Max.)
June 2— " 1·1 c.f.s.

Blue-earth lake is situated at the head of Blue-earth creek, and is surrounded by high hills; there are, in fact, two lakes of which the upper has an area about one-half that of the lower. The upper lake is 5·7 feet higher than the lower, to which it is connected by a small stream on which there is a beaver dam.

The superficial area of the two lakes at normal water level is 45 acres (by actual traverse survey). The area to the 20-foot contour is 74 acres, and the capacity of the reservoir to that contour is 1,100 acre-feet.

Some years ago a timber-cribbed dam, 20 feet high, was built at the outlet of the lake, the idea being to raise the level of the lake and conduct the water through a cut in the short Twaal creek divide down Twaal creek toward Spence's Bridge; it was afterwards found that the supply of water was insufficient, the average run-off being from 700 to 1,000 acre-feet only per annum. This dam failed two years ago, and has not been reconstructed.

The divide into Twaal creek is 26 feet above Blue-earth lake, and about 200 or 300 yards across.

BOLEAN CREEK (306).

Bolean creek rises in the hills near the head-waters of Chase creek, in township 19, range 13, west of the 6th meridian, at an elevation of 3,000 feet, and empties into Salmon river near Slahaltkan, at an elevation of 1,700 feet. The stream is about 10

miles long, with a drainage area of 80 square miles; it lies at the eastern limit of the dry belt, where the annual precipitation averages about 20 inches, and some irrigation is necessary.

There are some excellent gypsum deposits in this valley.

The station on Bolean creek, which is known also as Currie's creek and, locally, as Six-mile creek, is located half a mile from its mouth. The gauge is a standard vertical staff gauge located on the left bank of Bolean creek, three-quarters of a mile above Falkland post office.

Low-water measurements are made by wading; while in high stages the meter is suspended by a cable from a log across the stream. The banks are two feet high and are well wooded with cedar. The stream is confined to one channel, and there is no chance of overflow. Three bench-marks have been located, and the markings on them refer to the datum of the gauge.

DISCHARGE MEASUREMENTS of Bolean Creek, near Slahaltkan, for 1911.

Date.	Hydrographer.	Meter No.	Width.	Area of Section.	Mean Velocity.	Gauge Height.	Discharge.
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 23	W. M. Carlyle	1044	24	58·5	3·2	2·20	183
June 16	"	1044	24	48·4	2·6	1·95	127
July 12	"	1044	23	34·6	2·5	1·81	87
July 26	"	1044	17	15·1	1·3	1·24	20·3
Aug. 21	"	1044	16	11·8	0·8	1·02	10·1
1912.							
May 13	C. E. Richardson	1048	25	61·2	4·3	2·55	263
July 16	"	1048	23	18·9	1·7	1·39	31·4

DAILY GUAGE HEIGHT AND DISCHARGE of

Day.	MAY.		JUNE.		JULY.		AUGUST.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			2·5	251	1·65	68·8	1·10	13·0
2			2·52	256	1·62	64·1	1·08	12·0
3			2·42	232	1·55	54·2	1·05	10·5
4			2·30	204	1·50	47·5	1·05	10·5
5			2·12	163	1·48	45·2	1·05	10·5
6			2·08	154	1·45	41·7	1·05	10·5
7			2·02	140	1·50	47·5	1·40	35·8
8			1·98	132	2·12	163	1·50	47·5
9			2·00	136	2·12	163	1·32	28·4
10			1·95	125	1·95	125	1·22	20·5
11			2·02	140	1·90	114	1·15	16·0
12			2·10	158	1·80	94·8	1·15	16·0
13			2·07	151	1·70	76·5	1·10	13·0
14			2·05	147	1·62	64·1	1·10	13·0
15			2·00	136	1·60	61·0	1·10	13·0
16			1·92	118	1·55	54·2	1·05	10·5
17			1·85	104	1·50	47·5	1·02	9·0
18			1·82	98·6	1·48	45·2	1·00	8·0
19			1·75	85·6	1·45	41·7	0·98	7·3
20			1·70	76·5	1·38	33·9	1·05	10·5
21			1·65	68·8	1·35	31·2	1·02	9·0
22			1·68	73·4	1·35	31·2	1·05	10·5
23	2·2	181	1·68	73·4	1·35	31·2	1·05	10·5
24	2·15	170	1·60	61·0	1·32	28·4	1·00	8·0
25	2·12	163	1·58	58·3	1·28	25·0	0·98	7·3
26	2·08	154	1·58	58·3	1·25	22·8	0·95	6·2
27	2·05	147	1·70	76·5	1·22	20·5	0·95	6·2
28	2·05	147	1·62	64·1	1·18	17·8	0·92	5·2
29	2·10	158	1·58	58·3	1·15	16·0	0·90	4·5
30	2·22	186	1·58	58·3	1·12	14·2	0·30	4·5
31	2·35	216			1·10	13·0	0·90	4·5

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Bolean Creek, near Slahaltkan, for 1911.

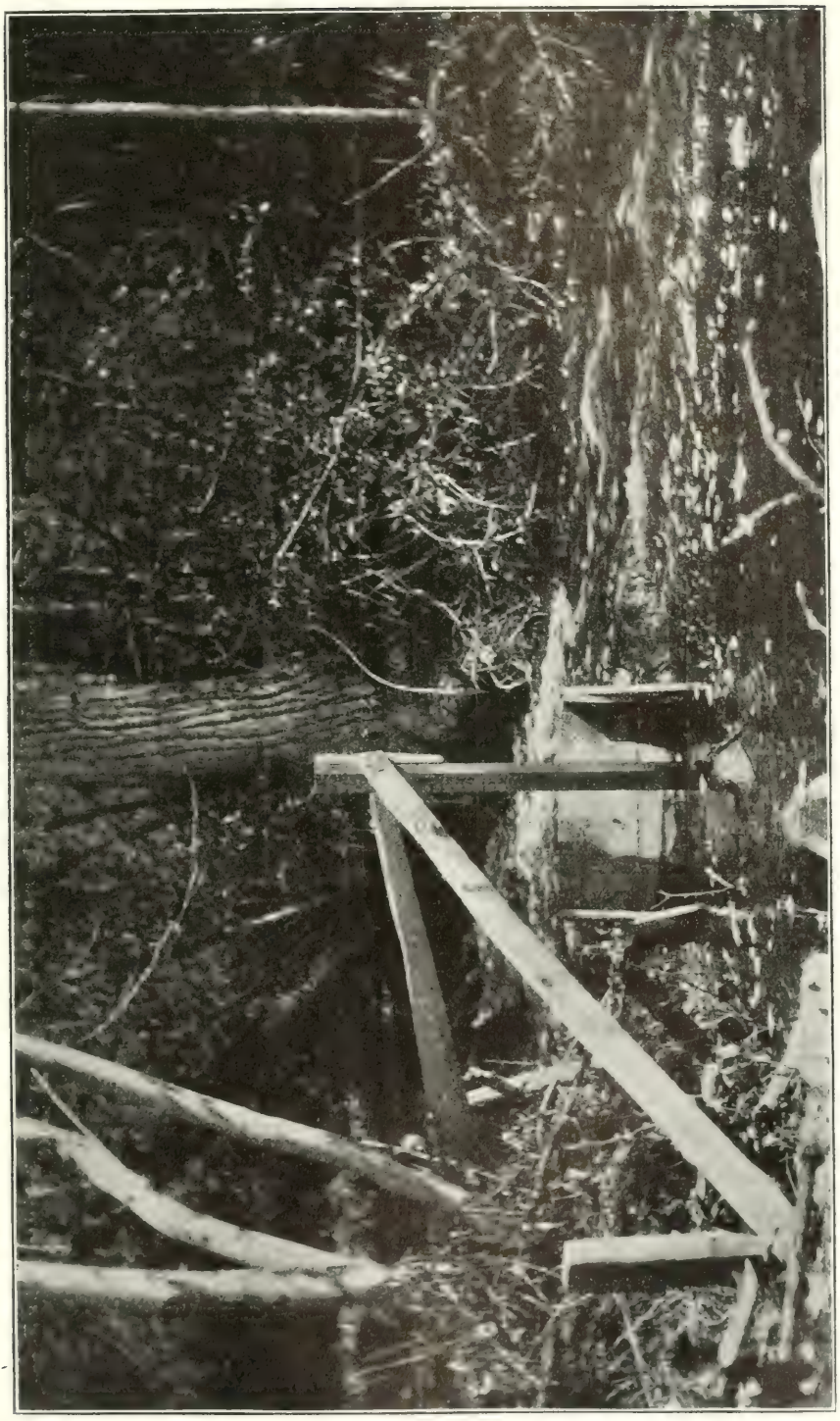
September.		October.		November.		December.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
0·85	3·1	1·10	13·0	0·90	4·5	1·15	16·0	1
0·85	3·1	1·05	10·5	0·90	4·5	1·15	16·0	2
0·88	4·0	1·05	10·5	0·92	5·2	1·05	10·4	3
1·12	14·2	1·05	10·5	1·05	10·5	1·05	10·4	4
1·18	17·8	1·00	8·0	1·05	10·5	1·05	10·4	5
1·08	12·0	1·00	8·0	1·02	9·0	1·05	10·4	6
1·05	10·5	1·00	8·0	1·05	10·5	1·05	10·4	7
1·02	9·0	0·98	7·3	1·05	10·5	1·05	10·4	8
0·98	7·3	0·95	6·2	1·10	13·0	1·10	13·0	9
0·95	6·2	0·95	6·2	1·05	10·5	1·10	13·0	10
0·92	5·2	0·95	6·2	1·05	10·5	1·10	13·0	11
0·90	4·5	0·92	5·2	1·00	8·0	1·05	10·4	12
1·05	10·5	0·90	4·5	0·95	6·2	1·05	10·4	13
1·42	38·1	1·05	10·5	0·95	6·2	1·10	13·0	14
1·32	28·4	1·05	10·5	0·95	6·2	1·05	10·4	15
1·30	26·5	1·05	10·5	1·00	8·0	1·05	10·4	16
1·20	19·0	1·05	10·5	1·08	12·0	1·05	10·4	17
1·15	16·0	1·00	8·0	1·22	20·5	1·10	13·0	18
1·12	14·2	1·00	8·0	1·25	22·8	1·10	13·0	19
1·10	13·0	1·00	8·0	1·20	19·0	1·10	13·0	20
1·10	13·0	0·98	7·3	1·15	16·0	1·07	11·6	21
1·08	12·0	0·95	6·2	1·10	13·0	1·05	10·4	22
1·05	10·5	0·95	6·2	1·15	16·0	1·05	10·4	23
1·05	10·5	1·05	10·5	1·15	16·0	1·05	10·4	24
1·05	10·5	1·02	9·0	1·2	19·0	1·15	16·0	25
1·05	10·5	1·00	8·0	1·2	19·0	1·15	16·0	26
1·00	8·0	0·95	6·2	1·2	19·0	1·15	16·0	27
1·05	10·5	0·95	6·2	1·2	19·0	1·25	22·8	28
1·08	12·0	0·95	6·2	1·4	35·8	1·15	16·0	29
1·10	13·0	0·95	6·2	1·1	13·0	1·05	10·4	30
.....	.....	0·90	4·5	...	...	1·05	10·4	31

MONTHLY DISCHARGE of Bolean Creek, near Slahaltkan, for 1911.

(*Drainage area, 80 square miles.*)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	256	58·3	122	1·52	1·7	7,260	
July	163	13	55	0·7	0·8	3,382	
August	47·5	4·5	12·6	0·16	0·18	775	
September	38	3·1	12·4	0·15	0·17	738	
October	13	4·5	8·0	0·1	0·1	492	
November	35·8	4·5	13·1	0·16	0·18	780	
December	22·8	10·4	12·5	0·16	0·18	769	
The period							16

NOTE.—Accuracy "A", except during the month of December, when the discharges are probably slightly in excess of the true amounts.



Boleau Creek, near Grande Prairie, B.C.

DAILY GAUGE HEIGHT AND DISCHARGE of

	JANUARY.		FEBRUARY.		MARCH.		APRIL.	
Day.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	1·05	10·4	1·05	10·4	1·00	8·0	1·15	16·0
2	1·10	13·0	1·10	13·0	1·00	8·0	1·22	20·9
3	1·05	10·4	1·10	13·0	1·00	8·0	1·27	24·6
4	1·00	8·0	1·10	13·0	1·00	8·0	1·22	20·9
5	1·00	8·0	1·05	10·4	1·00	8·0	1·20	19·0
6	1·00	8·0	1·05	10·4	1·00	8·0	1·27	24·6
7	1·00	8·0	1·05	10·4	1·00	8·0	1·27	24·6
8	1·00	8·0	1·10	13·0	1·00	8·0	1·27	24·6
9	1·05	10·4	1·10	13·0	1·00	8·0	1·32	28·8
10	1·05	10·4	1·10	13·0	1·00	8·0	1·32	28·8
11	1·05	10·4	1·10	13·0	0·95	6·3	1·37	33·4
12	1·05	10·4	1·10	13·0	0·95	6·3	1·57	57·7
13	1·07	11·6	1·05	10·4	0·95	6·3	1·57	57·7
14	1·12	14·5	1·05	10·4	0·95	6·3	1·60	61·0
15	1·15	16·0	1·05	10·4	0·9	4·5	1·60	61·0
16	1·10	13·0	1·05	10·4	0·95	6·3	1·60	61·0
17	1·05	10·4	1·05	10·4	0·95	6·3	1·62	64·9
18	1·05	10·4	1·10	13·0	1·00	8·0	1·60	61·0
19	1·05	10·4	1·10	13·0	1·00	8·0	1·62	64·9
20	1·05	10·4	1·05	10·4	1·00	8·0	1·62	64·9
21	1·05	10·4	1·05	10·4	1·00	8·0	1·62	64·9
22	1·05	10·4	1·05	10·4	1·00	8·0	1·65	68·8
23	1·00	8·0	1·05	10·4	1·00	8·0	1·67	72·7
24	1·00	8·0	1·05	10·4	1·00	8·0	1·70	76·5
25	1·05	10·4	1·05	10·4	1·00	8·0	1·70	76·5
26	1·05	10·4	1·00	8·0	1·00	8·0	1·75	85·7
27	1·05	10·4	1·00	8·0	1·05	10·4	1·75	85·7
28	1·10	13·0	1·00	8·0	1·10	13·0	1·75	85·7
29	1·10	13·0	1·00	8·0	1·10	13·0	1·80	94·8
30	1·15	16·0	.....	.....	1·07	11·6	·95	125·
31	1·10	13·0	.....	.....	1·10	13·0	.....	.....

SESSIONAL PAPER No. 25f

Bolean Creek, near Slahaltkan, for 1912.

May.		June.		July.		August.		September.		Day.
Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height	Discharge	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
1·90	114	2·37	221	1·55	54·3	1·15	16·0	1·37	33·4	1
1·90	114	2·37	221	1·57	57·7	1·10	13·0	1·40	35·8	2
1·97	130	2·25	192	1·77	90·3	1·12	14·5	1·47	44·5	3
2·05	147	2·22	187	1·65	68·8	1·15	16·0	1·42	38·7	4
2·12	164	2·20	181	1·60	61·0	1·12	14·5	1·35	31·1	5
2·20	181	2·17	175	1·60	61·0	1·07	11·6	1·32	28·8	6
2·22	187	2·20	181	1·67	72·7	1·05	10·4	1·45	41·6	7
2·47	245	2·25	192	1·62	64·9	1·05	10·4	1·50	47·5	8
2·62	282	2·22	187	1·55	54·3	1·02	9·2	1·45	41·6	9
2·55	263	2·15	169	1·52	50·9	1·00	8·0	1·40	35·8	10
2·52	257	2·10	158	1·50	47·5	1·05	10·4	1·32	28·8	11
2·55	263	2·12	164	1·52	50·9	1·10	13·0	1·35	31·1	12
2·57	269	2·20	181	1·55	54·3	1·07	11·6	1·30	26·5	13
2·85	342	2·20	181	1·52	50·9	1·05	10·4	1·30	26·5	14
3·00	382	2·47	245	1·47	44·5	1·07	11·6	1·30	26·5	15
3·10	412	2·50	251	1·40	35·8	1·15	16·0	1·25	22·5	16
2·92	362	2·25	192	1·40	35·8	1·20	19·0	.....	.....	17
2·82	335	2·10	158	1·35	31·1	1·30	26·5	..	.....	18
2·82	335	2·02	141	1·35	31·1	1·25	22·8	....	....	19
2·92	262	2·00	136	1·30	26·5	1·20	19·0	....	..	20
3·00	382	1·87	109	1·30	26·5	1·20	19·0	...		21
2·92	362	1·77	90·3	1·30	26·5	1·15	16·0			22
2·92	362	1·67	72·7	1·27	24·6	1·15	16·0		....	23
3·00	382	1·60	61·0	1·27	24·6	1·12	14·5	..		24
2·90	355	1·55	54·3	1·40	35·8	1·20	19·0	.		25
2·95	369	1·55	54·3	1·35	31·1	1·15	16·0			26
2·87	349	1·55	54·3	1·35	31·1	1·15	16·0			27
2·75	315	1·55	54·3	1·30	26·5	1·10	13·0	..		28
2·57	269	1·50	47·5	1·25	22·8	1·15	16·0	.		29
2·50	251	1·50	47·5	1·22	20·9	1·27	24·6	.		30
2·45	239	.....	.....	1·17	17·5	1·25	22·8			31

MONTHLY DISCHARGE of Bolean Creek, near Slahaltkan, for 1912.

(Drainage area, 80 square miles.)

Month	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL
	Maximum	Minimum	Mean	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
January	16·0	8·0	10·8	0·14	0·15	664	
February	13·0	8·0	11·0	0·14	0·15	633	
March	13·0	4·5	8·2	0·10	0·11	504	
April	125	16·0	55·2	0·69	0·77	3,285	
May	412	114	283	3·54	4·08	17,400	
June	251	47·5	145	1·81	2·02	8,630	
July	90	17·5	43	0·54	0·62	2,644	
August	26·5	8·0	15·4	0·19	0·22	947	
September	47·5		25·0	0·31	0·35	1,490	
October			*10·	0·12	0·14		
November			*10·	0·12	0·14	2,000	
December			*10·	0·12	0·14		
The year	412	4·5	52·2	0·65	8·89	38,197	18

NOTE.—Discharges from December 1911 to March 1912, were deduced from a summer curve, and as winter conditions existed they are probably in excess (slightly) of the true discharges. The station was discontinued on September 12.

*The estimated mean flow of October, November and December is 10 second-feet.

Accuracy "A," except for month of April, when it is "B."

BONAPARTE RIVER (215).

Bonaparte river rises in Bonaparte lake at an elevation of 3,800 feet, and discharges into Thompson river near Ashcroft at an elevation of 970 feet; Hat creek and Maiden creek (Graves creek) flow in from the west, Cache creek and Scottie creek from the east, the total discharge area being 2,000 square miles. The water is used for irrigation and for water-power. An attempt was made at the power plant of the Ashcroft Water, Electric and Improvement Company to pump water to the Boston flat, using power obtained from the river; owing to the high elevation to which the water had to be raised, too large a flow of water was required to supply the power, therefore the scheme was not successful.

The Bonaparte drains a large watershed lying between the Fraser and the North Thompson, and at the head-waters of several of its branches there are lakes varying in elevation from 2,000 to 3,000 feet; the largest of these is Bonaparte lake, which is about ten miles long and two miles wide.

Near Ashcroft, the Bonaparte has worn a canyon, through which it flows for three miles or so; near the upper end of this canyon the power-house which supplies Ashcroft with power and light is situated; although there are other sites in the canyon, it is doubtful whether there will be much more power development on the stream as the water is in demand for irrigation.

Below the canyon there is some good land; the bottom land is being cultivated and irrigated, but the higher benches are arid. About six miles from the mouth of the river, the valley broadens out, and for fifteen miles there is a fine stretch of good country. The Cariboo road runs up the valley and a good deal of the land was taken up in the early days of the province; even now the traffic on this road to Fort George and the northern interior is the largest factor in the prosperity of the Bonaparte

valley; passengers are carried by automobiles and make the run through to the boat landing at Soda creek on the Upper Fraser in one day. Freighting is still done entirely by horses and wagons, travelling about twenty miles a day, and furnishing a good demand for hay and oats.

The Bonaparte valley is in the dry belt; during the growing season there is almost continuous sunshine, with very little rain, and consequently nothing will grow without irrigation; the soil is naturally rich, and when water is supplied the growth is rapid. At present most of the lower land in the Bonaparte and tributary valleys is under cultivation, and the water supply is about sufficient under the present methods of irrigation. There is much good land, however, on the higher benches in the Semlin valley, and on the Boston flat, which could be irrigated by a long flume from the Bonaparte river and, if the storage on the lakes were utilized, there would be sufficient water, and if one system were constructed to serve all the price per acre would not be excessive.

Potatoes do exceptionally well on this land. Ashcroft potatoes have quite a reputation, and bring the highest prices. In the summer, large herds of cattle feed on the good pasturage on the hills, but as they must be fed during the winter there is good market for hay; thus, even now, the Ashcroft district is a good farming country, and could be much improved by an extensive irrigation system.

Twenty miles from the mouth of the river, quite near the boundary of the Railway Belt, the wagon road leaves the Bonaparte valley and climbs to the plateau, the best part of the valley being inside this belt. North of the boundary the altitude is higher, the precipitation somewhat heavier, and there is more timber. It is in this part of the watershed that all the lakes lie; there is splendid fishing in many of them and Indians go up there every fall in large numbers to catch fish for the winter. The Cariboo road does not touch the main stream outside the Railway Belt, and the only means of travelling is by pack trail.

The gauging station on the Bonaparte is at Mr. J. G. Collin's ranch, about six miles from the mouth of the stream, above the Ashcroft power-house, and not far from the upper end of the canyon. The gauge is a five-foot vertical staff nailed to some small trees on the right bank of the stream at Collin's house, and is referred to three bench-marks so that any change of elevation can be detected and corrected.

The meter measurements are made at a section about 100 feet above the gauge, where a wire has been stretched across the stream; at high water a carrier is put on this wire and the meter suspended from it by a cable, while at low and medium stages the measurements are made by wading. The channel above the section is straight for 100 feet, and the water is swift; below, the channel is straight for 150 feet and the water, though obstructed by one or two boulders, swift.

The right bank is two feet high, with a fringe of bushes and small trees, and at very high stages the water might rise into the bushes; the left bank is four feet high and covered with bushes and trees; there could be only one channel even at high water. The bed of the stream is rocky, and the water is about two feet deep at ordinary stages; at the highest stages it is impossible to wade it; at very low water it might be necessary to remove a few shovelfuls of mud to keep open the communication between the little pool in which the gauge is placed and the main stream, though at ordinary stages the gauge is in the main stream itself.

DISCHARGE MEASUREMENTS of Bonaparte River, five miles from mouth, for 1911 and 1912.

Date	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
1911.							
June 10	C. G. Cline	1046	62	109	3·3	2·25	364
July 14	"	1046	50	81	2·2	1·49	177
Sept. 26	Cline and Smith	1046	37	40	1·7	0·99	67
Sept. 26	"	1046	37	40·5	1·7	0·99	70
1912.							
April 24	C. G. Cline	1046	46	78·6	2·9	1·57	226
May 9	"	1046	52	153·	4·9	3·10	756
June 16	Cline and Corbould	1046	45	93·	3·2	1·95	297
July 17	B. Corbould	1044				1·65	229
July 30	"	1044	50	100	2·8	1·70	289
August 26	"	1044	43	79	2·3	1·35	186
Oct. 3	C. G. Cline	1046	38	48	1·8	1·08	87

DAILY GAUGE HEIGHT AND DISCHARGE of Bonaparte River, five miles from mouth for 1911.

Day.	June.		July.		August.		September.		October.		November.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·6	207	1·15	102	0·75	25	0·95	59	0·9	50
2			1·6	207	1·15	102	0·7	18	0·95	59	0·9	50
3			1·6	207	1·15	102	0·7	18	0·95	59	0·9	50
4			1·6	207	1·1	90	0·75	25	0·95	59	0·9	50
5			1·6	207	1·1	90	0·75	25	0·95	59	0·9	50
6			1·55	195	1·1	90	0·75	25	0·9	50	0·9	50
7			1·55	195	1·05	79	0·75	25	0·9	50		
8			1·55	195	1·15	102	0·75	25	0·9	50		
9			1·55	195	1·05	79	0·75	25	0·9	50		
10	2·25	375	1·55	195	1·05	79	0·75	25	0·85	42		
11	2·25	375	1·5	183	1·0	68	0·75	25	0·85	42		
12	2·3	390	1·5	183	1·0	68	0·75	25	0·85	42		
13	2·35	405	1·5	183	1·0	68	0·9	50	0·85	42		
14	2·35	405	1·5	183	0·95	59	0·95	59	0·85	42		
15	2·3	390	1·45	171	0·95	59	1·0	68	0·85	42		
16	2·2	260	1·45	171	0·95	59	1·05	79	0·85	42		
17	2·15	345	1·45	171	0·95	59	1·05	79	0·9	50		
18	2·0	305	1·4	159	0·9	50	1·05	79	0·9	50		
19	2·0	305	1·4	159	0·9	50	1·05	79	0·9	50		
20	1·9	280	1·4	159	0·9	50	1·0	68	0·9	50		
21	1·8	256	1·4	159	0·85	42	1·0	68	0·9	50		
22	1·8	256	1·4	159	0·85	42	1·0	68	0·9	50		
23	1·7	232	1·35	148	0·85	42	1·0	68	0·9	50		
24	1·7	232	1·35	148	0·85	42	1·0	68	0·9	50		
25	1·7	232	1·3	136	0·85	42	1·0	68	0·9	50		
26	1·7	232	1·3	136	0·8	33	1·0	68	0·9	50		
27	1·7	232	1·3	136	0·8	33	1·0	68	0·9	50		
28	1·65	220	1·25	124	0·8	33	1·0	68	0·9	50		
29	1·65	220	1·25	124	0·75	25	1·0	68	0·9	50		
30	1·6	207	1·2	113	0·75	25	0·95	59	0·9	50		
31			1·2	113	0·75	25			0·9	50		

MONTHLY DISCHARGE of Bonaparte River, five miles from mouth, for 1911.

(Drainage area, 2,000 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	405	207	284	0·14	0·16	16,900	
July	207	113	169	0·08	0·09	10,400	
August	102	25	61	0·03	0·04	3,750	
September	79	18	50·6	0·025	0·03	3,010	
October	59	42	49·6	0·025	0·03	3,050	
The period							10

NOTE.—Station established June 10, 1911.
Accuracy, "C."

Daily Gauge Height and Discharge of Bonaparte

Day.	March.		April.		May.		June.		July.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·2	113	2·7	535	2·7	535	1·75	244
2			1·25	125	2·8	580	2·65	515	1·8	256
3			1·3	136	2·85	605	2·65	515	1·9	280
4			1·25	125	2·9	630	2·65	515	2·0	305
5			1·2	113	2·9	630	2·5	455	2·05	317
6			1·2	113	2·95	660	2·4	420	2·0	305
7			1·1	90	3·0	690	2·3	390	1·9	280
8			1·15	102	3·05	720	2·25	375	1·85	268
9			1·2	113	3·1	755	2·2	360	1·8	256
10			1·15	102	3·15	795	2·2	360	1·8	256
11			1·2	113	3·2	830	2·15	345	1·75	244
12			1·2	113	3·15	795	2·15	345	1·75	244
13			1·25	125	3·15	795	2·1	330	1·8	256
14			1·25	125	3·2	830	2·0	305	1·8	256
15			1·25	125	3·15	795	1·95	292	1·75	244
16			1·2	113	3·1	755	1·9	280	1·7	232
17			1·1	90	3·1	755	1·9	280	1·7	232
18			1·15	102	3·0	690	1·9	280	1·65	220
19			1·25	125	2·9	630	1·85	268	1·6	207
20			1·2	113	2·9	630	1·85	268	1·6	207
21			1·25	125	2·95	660	1·9	280	1·55	195
22			1·25	125	2·9	630	1·85	268	1·6	207
23			1·4	159	2·85	605	1·8	256	1·65	220
24			1·6	207	2·85	605	1·8	256	1·75	244
25	0·8	33	1·8	256	2·9	630	1·75	244	1·85	268
26	0·85	42	2·1	330	2·9	630	1·75	244	1·8	256
27	0·85	42	2·3	390	2·9	630	1·75	244	1·75	244
28	0·9	50	2·6	495	2·85	605	1·8	356	1·75	244
29	0·95	59	2·5	455	2·85	605	1·85	268	1·7	232
30	1·05	79	2·6	495	2·85	605	1·85	268	1·7	232
31	1·1	90			2·75	560			1·65	220

River, five miles from mouth for 1912.

August.		September.		October.		November.		December.		Day
Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
1·6	207	1·35	148	1·1	90	1·17	106	1·05	79	1
1·6	207	1·35	148	1·1	90	1·17	106	1·05	79	2
1·55	195	1·4	159	1·1	90	1·17	106	1·05	79	3
1·55	195	1·4	159	1·1	90	1·17	106	1·05	79	4
1·5	183	1·45	171	1·1	90	1·15	102	1·1	90	5
1·45	171	1·5	183	1·1	90	1·15	102	1·1	90	6
1·45	171	1·5	183	1·1	90	1·15	102	1·05	79	7
1·45	171	1·5	183	1·1	90	1·15	102	1·05	79	8
1·45	171	1·5	183	1·15	102	1·15	102	1·05	79	9
1·4	159	1·45	171	1·15	102	1·15	102	1·05	79	10
1·4	159	1·45	171	1·15	102	1·15	102	1·07	83	11
1·4	159	1·45	171	1·2	113	1·15	102	1·07	83	12
1·4	159	1·4	159	1·2	113	1·15	102	1·1	90	13
1·4	159	1·4	159	1·2	113	1·1	90	1·1	90	14
1·45	171	1·35	148	1·2	113	1·1	90	1·1	90	15
1·5	183	1·35	148	1·2	113	1·1	90	1·1	90	16
1·5	183	1·3	136	1·2	113	1·1	90	1·07	83	17
1·5	183	1·25	125	1·2	113	1·1	90	1·07	83	18
1·45	171	1·25	125	1·2	113	1·12	95	1·07	83	19
1·45	171	1·2	113	1·2	113	1·12	95	1·1	90	20
1·45	171	1·2	113	1·2	113	1·1	90	1·1	90	21
1·4	159	1·2	113	1·2	113	1·1	90	1·1	90	22
1·4	159	1·15	102	1·2	113	1·07	83			23
1·4	159	1·15	102	1·2	113	1·07	83			24
1·35	148	1·15	102	1·2	113	1·07	83			25
1·35	148	1·1	90	1·2	113	1·07	83			26
1·35	148	1·1	90	1·2	113	1·05	79			27
1·35	148	1·1	90	1·2	113	1·05	79			28
1·35	148	1·1	90	1·17	106	1·05	79			29
1·3	136	1·1	90	1·17	106	1·05	79			30
1·3	136			1·17	106					31

MONTHLY DISCHARGE of Bonaparte River, five miles from mouth, for 1912.

(Drainage area, 2,000 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	495	90	177	0·09	0·10	10,500	
May	830	535	673	0·33	0·38	41,400	
June	535	244	334	0·17	0·19	19,900	
July	317	195	247	0·12	0·14	15,200	
August	207	136	167	0·08	0·09	10,300	
September	183	90	137	0·07	0·08	8,150	
October	113	90	105	0·05	0·06	6,460	
November	106	79	93	0·05	0·06	5,530	
December	90	79	84	0·04	0·05	5,165	
The period							10

NOTE.—Accuracy, "C."

BOTANIE CREEK (205).

Botanie creek has its source in Botanie lake (in Botanie I.R., No. 15), in township 16, range 26, west of the 6th meridian, at an elevation of 3,500 feet, and discharges into Thompson river, 3 miles from Lytton, at an elevation of 650 feet. Botanie creek lies within the Dry Belt, is about nine or ten miles long and flows in a southerly direction. Its drainage area above the mouth is 38 square miles, and the annual precipitation is only about 10 inches: the water is used for irrigation and domestic purposes.

There are about 400 acres of land that can be easily irrigated from Botanie creek; this consists of bench land, the soil of which is good consisting of heavy sandy loam with clay subsoil. These benches are in some cases 200 to 300 feet above the creek, but owing to the steep slope of the creek long ditches are not required.

There are a number of old water records for Botanie creek for irrigation purposes amounting to about 850 miner's inches, but this amount of water is unnecessary for the land under cultivation or for the total amount of irrigable land appurtenant to the records.

To increase the flow of Botanie creek, which falls very low during July and August, the Indians have diverted water from the creek into Botanie lake, where there is an excellent site for a Skoonko storage dam; this lake has an area of 60 acres and a twelve-foot dam would store 720 acre-feet of water. Botanie creek has a fall of about 300 feet to the mile for 9 miles and, with a small pipe line, about 100 horse-power could be developed during the irrigation season, but the water would have to be regulated for the irrigation requirements, which are paramount.

The station, which was established on September 21, 1911, by C. E. Richardson is, above all diversions, some 5 miles below Botanie lake and 7 miles from the town of Lytton. Weekly gauge readings were taken to the end of November, in 1911, and from April 1 to September 10 in 1912.

The gauge is a vertical staff gauge (cedar), 2 inches by 4 inches by 6 feet, marked in feet and tenths, and measurements are made by wading. The stream is swift, its bed rocky, and although confined to one channel a smooth stretch of water for a measuring section was hard to find.

DISCHARGE MEASUREMENTS of Botanie Creek, above diversions, for 1911 and 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
1911.							
Sept. 21	C. E. Richardson	1048	11	4·4	0·94	1·33	4·2
1912.							
May 29	B. Corbould	1053	13	7·9	1·8	1·62	14·3

DAILY GAUGE HEIGHT AND DISCHARGE of Botanie Creek, above diversions, for 1911.

Day.	September.		October.		November.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·25	2·6		3·6
2				2·8	1·3	3·6
3				3·0		3·6
4				3·1		3·6
5				3·1		3·6
6				3·2		3·6
7				3·2		3·6
8				3·3		3·6
9				3·4		3·6
10				3·5	1·3	3·6
11				3·5		3·4
12			1·3	3·6		3·2
13				3·6		3·1
14				3·6		3·0
15				3·6		2·9
16				3·6		2·8
17				3·6		2·7
18				3·6	1·25	2·6
19			1·3	3·6		2·7
20				3·6		2·8
21	1·3	3·6		3·6		2·9
22				3·6		3·0
23				3·6		3·2
24				3·6		3·4
25				3·6	1·3	3·6
26			1·3	3·6		3·6
27				3·6		3·6
28	1·3	3·6		3·6		3·6
29				3·6		3·6
30				3·6		3·6
31				3·6		

MONTHLY DISCHARGE of Botanie Creek, above diversions, for 1911.

(Drainage area, 38 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
October	3·6	2·6	3·4	·09	·10	209	
November	3·6	2·6	3·3	·09	·10	196	
The period							10

NOTE.—Accuracy, "B."

DAILY GAUGE HEIGHT AND DISCHARGE of Botanie Creek, above diversions, for 1912.

Day.	April.		May.		June.		July.		August.		September.	
	Gauge height.	Discharge.	Gauge height.	Discharge	Gauge height.	Discharge.	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		3·6		12·6		10·2		6·2	1·3	3·6		
2		3·6		12·9		9·2		6·2		3·6		
3		3·6		13·2		8·2	1·4	6·2		3·6		
4		3·6	1·6	13·5		7·2		6·2		3·6		
5		3·6		14·4	1·4	6·2		6·2		3·6		
6	1·3	3·6		15·3		6·2		6·2		3·6		
7		3·6		16·2		6·2		6·2	1·3	3·6		
8		3·6		17·1		6·2		6·2		3·6		
9		3·6	1·7	17·9		6·2		6·2		3·6		
10	1·3	3·6		18·2		6·2	1·4	6·2		3·6	1·25	2·6
11		4·1		18·5		6·2		5·8		3·6		
12		4·6		18·8	1·4	6·2		5·4	1·3	3·6		
13		5·1		19·2		6·2		5·0		3·8		
14		5·6		19·6		6·2		4·6		4·0		
15	1·4	6·2	1·75	20·1		6·2		4·1		4·2		
16		6·7		20·4		6·2	1·3	3·6		4·4		
17		7·2		20·7		6·2		3·6		4·6		
18		7·9		21·1		6·2		3·6	1·35	4·9		
19		8·2		21·5		6·2		3·6		4·8		
20		8·7		21·9		6·2		3·6		4·6		
21		9·2	1·8	22·3		6·2		3·6		4·4		
22	1·5	9·6		21·2		6·2	1·3	3·6		4·2		
23		10·0		20·1		6·2		3·6		4·0		
24		10·4		19·0		6·2		3·6		3·8		
25		10·8		17·9		6·2		3·6	1·3	3·6		
26		11·2		16·8		6·2		3·6		3·4		
27	1·55	11·6		16·7		6·2	1·3	3·6		3·2		
28		11·8		16·6		6·2		3·6		3·1		
29		12·0	1·6	13·5		6·2		3·6		3·0		
30		12·3		12·4		6·2		3·6		2·8		
31				11·3				3·6	1·25	2·6		

MONTHLY DISCHARGE of Botanie Creek, above diversions, for 1912.

(Drainage area, 38 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	12·3	3·6	6·9	0·18	0·20	410	
May	22·3	11·3	17·4	0·46	0·53	1,070	
June	10·2	6·2	6·5	0·17	0·19	387	
July	6·2	3·6	4·7	0·12	0·14	289	
August	4·9	2·6	3·8	0·10	0·11	234	
The period							10

NOTE.—Station maintained during irrigation season only.
Accuracy "B" and "C."

BUGABOO CREEK (419).

Bugaboo river, with a drainage area of 190 square miles, lies in the Upper Columbia district and has its source in the Selkirk mountains at an elevation of 6,000 feet to 9,000 feet, discharging into Columbia river near Spillimacheen Landing, at an elevation of 2,600 feet; the precipitation near the source in average years is very heavy, probably 60 inches, while near the mouth it is only about 10 inches.

Bugaboo river behaves in a similar manner to Spillimacheen river, which empties into the Columbia a few miles below the mouth of the Bugaboo. (See notes on drainage and run-off of Spillimacheen river.)

Bugaboo river is a mountain torrent. At the highway bridge, about one mile from its mouth, it is about 60 feet wide and 3 feet deep at high water, having a mean velocity of 6 feet per second. At low water it is 23 feet wide, 6 inches deep and has a mean velocity of 2 feet per second.

For the first mile above the mouth there is flooding at the high-water season of Columbia river. At a point 2 miles from the mouth, a canyon 1 mile long begins and the fall in that distance is 220 feet (measured by aneroid). At the head of the canyon there is a sheer fall of 60 feet, making a total of 280 feet. The river at the foot of the canyon is 50 feet wide, with precipitous banks rising 60 feet above the water, and at the head of the falls the river is 40 feet, with steeply sloping banks. There is no good storage lake or natural reservoir on Bugaboo river. The stream is used for log-driving, but there are no other important interests at present, although there are possible future uses of the water for power and mining.

The run-off of Bugaboo river is of importance during the winter low-water period in connection with water-power purposes, while the flood discharge has been studied in connection with the possible reclamation of the overflow bottom lands of the Upper Columbia valley from Golden to lake Windermere. The station on the Bugaboo was established by H. C. Hughes on June 1, 1912. Continuous gauge readings were taken till October 31, 1912, after which ice conditions began to prevail.

The measuring section is located one mile from the mouth on the downstream side of the traffic bridge carrying the highway, which runs along the west bank of the Columbia, from Spillimacheen to Wilmer. The gauge, a standard vertical staff gauge, is nailed on the bridge pier nearest the right shore. The flow is measured by a current meter suspended by a cable from the bridge. The bed of the stream is rough and

rocky, and its banks low and bushy; at high water there are two channels, and at extremely high water the banks are liable to overflow. Three bench-marks have been located and referred to the gauge datum.

DISCHARGE MEASUREMENTS of Bugaboo River, near Spillimacheen, for 1912.

Date.	Hydrographer.	Meter No.	Width	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
June 1	H. C. Hughes	1055	23	96	2·9	1·45	280
June 18	" "	1055	60	130	6·1	2·40	840
July 16	" "	1055	59	128	5·3	2·15	684
Sept. 24	C. E. Richardson	1055	23	86	1·9	1·02	160

DAILY GAUGE HEIGHT AND DISCHARGE of Bugaboo River, near Spillimacheen, for 1912.

Day.	June.		July.		August.		September.		October.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	1·45	280	2·10	630	2·35	810	1·50	300	0·95	148
2	1·40	260	2·30	770	2·25	735	1·45	280	1·05	165
3	1·32	236	2·15	665	2·25	735	1·40	260	10·5	165
4	1·30	230	2·00	560	2·25	735	1·30	230	1·00	155
5	1·35	245	2·25	735	2·20	700	1·37	251	0·95	148
6	1·45	280	2·25	735	1·95	530	1·30	230	1·10	175
7	1·70	390	2·30	770	1·95	530	1·35	245	1·10	175
8	2·10	630	2·35	810	2·00	560	1·37	251	0.95	148
9	2·55	970	2·30	770	2·25	735	1·35	245	1·00	155
10	2·20	700	2·30	770	2·15	665	1·37	251	1·00	155
11	2·55	970	2·35	810	2·05	595	1·37	251	0·98	152
12	2·4	850	2·20	700	2·00	560	1·55	320	0·90	140
13	2·50	930	2·85	1,210	1·85	470	1·60	340	0·90	140
14	2·35	810	2·60	1,010	1·85	470	1·35	245	0·90	140
15	2·15	665	2·35	810	2·05	595	1·25	215	0·90	140
16	2·10	630	2·35	810	2·10	630	1·22	206	1·05	165
17	2·35	810	2·10	630	1·90	500	1·27	221	1·35	245
18	2·60	1,010	2·15	665	1·75	415	1·27	221	1·15	188
19	2·65	1,050	2·30	770	1·80	440	1·15	188	1·05	165
20	2·75	1,130	2·30	770	1·85	470	1·30	230	0·95	148
21	2·75	1,130	2·25	735	2·05	595	1·35	245	0·95	148
22	3·10	1,430	2·25	735	2·15	665	1·35	245	1·00	155
23	3·05	1,380	2·20	700	2·30	770	1·25	215	0·98	152
24	3·00	1,340	2·20	700	2·25	735	1·15	188	0·90	140
25	2·90	1,250	2·10	630	2·30	770	1·30	230	0·92	143
26	2·90	1,250	2·10	630	2·00	560	1·07	169	0·85	135
27	2·75	1,130	2·05	595	1·90	500	1·00	155	0·78	129
28	2·45	890	2·10	630	1·95	530	1·30	230	·070	123
29	2·15	665	2·20	700	1·75	415	1·00	155	0·70	123
30	2·10	630	2·30	720	1·60	340	1·05	165	0·60	118
31			2·35	810	1·50	300			0·60	118

MONTHLY DISCHARGE of Bugaboo River, near Spillimacheen, for June to October, 1912.
(Drainage area, 190 square miles.)

Month.	Discharge in Second Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	1,430	230	805	4·2	4·7	47,900	
July	1,210	560	743	3·9	4·5	45,700	
August	810	300	584	3·1	3·6	35,900	
September	340	155	233	1·2	1·3	13,900	
October	245	118	151	0·8	0·9	9,280	
The period							30

NOTE.—On October 31, river started to freeze over, and the station was abandoned for the season. The river will be clear of ice again about April 1.

Accuracy, "B."

The maximum discharge for 1912 was 1,430 c.f.s. on June 22. The maximum in the famous year of 1894 was probably about 3,000 c.f.s. The maximum of an average year probably would be 2,000 c.f.s. The estimated minimum flow is 50 c.f.s., taking place during the latter part of February and the first part of March.

CACHE CREEK (220).

Cache creek has its source in the hills northeast of Ashcroft, at an elevation of 5,500 feet and, flowing west, discharges into Bonaparte river 7 miles from its mouth, at an elevation of 1,400 feet. It is part of the Thompson drainage. Its drainage area is about 40 square miles. The water of Cache creek is used entirely for irrigation, and on account of the small run-off and its unreliability there is generally a water shortage in the middle of the summer.

Cache creek lies in the driest portion of the Dry Belt. The precipitation is only from 9 to 12 inches. The summers are very hot and dry, and the winters cold and dry.

Cache creek supplies the irrigation water for the land in the Semlin valley. This valley lies between the Bonaparte and Thompson valleys, connecting the two, and, like the Boston flat on the other side of the Bonaparte, is probably the old bed of a large stream or glacier which at one time flowed down the Bonaparte valley into the Thompson. The Semlin valley is about six miles long and at least half a mile wide. Only part of the land is under cultivation at present on account of the lack of sufficient water for irrigation. But the land is good and, when irrigated, yields good crops. It is this valley that has given the Ashcroft district its reputation for growing good potatoes. Large quantities of alfalfa are grown also for wintering the cattle, which find excellent pasturage in the hills during the summer.

The north branch of Cache creek rises in a wooded country, but the south branch in more open country. Between the two is a hill which rises to an elevation of 5,700 feet. There is a wagon road up the creek as far as the forks, and the fall is only moderate in that part of the creek. Above the forks, however, the stream falls quite rapidly. The road up Cache creek crosses the divide, passes along the head of Eight-mile creek, and comes out to Deadman river above the mouth of Criss creek.

A ditch has been dug to take water from the South branch of Cache creek and carry it to Tsotin lake, on Eight-mile creek. Where Tsotin lake can be filled in this way, it gives quite a supply of water. Eight-mile creek itself is very small. But it is only during the freshet that this diversion can be made, except in very

wet years, because the water is needed in the Semlin valley, where the oldest records are held. The Indians claim that there is a lake on the south branch of Cache creek, though its location does not seem to be definitely known. If this, or some other storage site could be utilized to store the flood waters, it would provide more water for the latter part of the irrigation season, when there is usually a shortage. There is also a possibility that there is a feasible route for a flume through the hills from Hihium lake to Cache creek. If such a flume could be built it would provide an abundant water supply for the Semlin valley. But probably the best plan would be to build a flume from the Bonaparte river to supply the Boston flats, and the land at the mouth of Cornwall and Oregon Jack creeks, with a pipe across the Bonaparte to supply the Semlin valley and other adjacent land on that side of the river. But that would take a lot of capital and would require some form of concerted action among the various land owners.

The gauge on Cache creek is 100 feet above the highest diversion, and so measures the whole flow of the stream. It was established on June 9, 1911, and weekly gauge readings were taken during the irrigation seasons of 1911 and 1912 by Mr. C. A. Semlin. The gauge is a five-foot staff, nailed and braced to a small tree stump on the left bank of the creek, 100 feet above the diversion dam. It is referred to three bench-marks. The meter measurements were made by wading at a section 10 feet above the diversion dam. The channel is straight between the gauge and the measuring section and the current is swift. Below the gauging section is a diverting dam which makes the water deeper and quieter. Both banks are high enough to prevent overflow and are covered with bushes. There was a lot of brush in the stream below the site of the gauge, but it was all removed when the gauge was installed.

DISCHARGE MEASUREMENTS of Cache Creek, above diversions, for 1911 and 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
1911							
June 9...	C. G. Cline...	1046	8·5	4·9	1·0	0·72	4·9
July 13..	"	1046	11·0	5·8	0·2	0·53	1·4
Sept. 25.	Cline and Smith...	1046	11·0	6·9	0·35	0·58	2·4
Sept. 25.	"	1046	12·0	7·5	0·3	0·58	2·4
1912							
May 8...	C. G. Cline.....	1046	15·4	15·4	4·2	1·65	64·6
May 13..	"	1046	12·0	15·4	3·2	1·52	49·5
June 13..	Cline and Corbould.	1046	10·0	4·3	1·5	0·86	6·6
July 13..	B. Corbould .	1044	8·0	3·4	1·5	0·85	5·2
Aug. 3...	"	1044	7·0	2·3	1·1	0·78	2·6
Aug. 29.....	"	1044	7·0	2·1	1·1	0·77	2·3

DAILY GAUGE HEIGHT AND DISCHARGE of Cache Creek, above diversions, for 1911.

Day.	JUNE.		JULY.		AUGUST.		SEPTEMBER.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		4·7		2·7		2·0		
2		4·7	0·6	2·7		2·5		
3		4·7		2·7		3·0		
4		4·7		2·7		3·5		
5		4·7		2·7		4·0		
6		4·7		2·7		4·3		
7		4·7		2·7	0·7	4·7		
8		4·7		2·7		4·4		
9	0·7	4·7		2·7		4·1		
10		4·7	0·6	2·7		3·8		
11	0·7	4·7		2·4		3·6		
12		4·7		2·1		3·4		
13		4·7		1·8		3·2		
14		4·7		1·5		3·0	0·7	4·7
15		4·7		1·2	0·6	2·7		
16		4·7	0·5	1·0		2·6		
17		4·7		1·0		2·4		
18	0·7	4·7		1·0		2·2		
19		4·3		1·0		2·0		
20		3·9		1·0		1·8		
21		3·5		1·0		1·6		
22		3·1		1·0		1·4		
23	0·6	2·7	0·5	1·0		1·2		
24		2·7		1·0	0·5	1·0	0·7	4·7
25		2·7		1·0		1·2		
26		2·7		1·0		1·5		
27		2·7		1·0		1·8		
28		2·7		1·0		2·1		
29		2·7		1·0		2·4		
30		2·7	0·5	1·0	0·6	2·7		
31		2·0		1·5		2·8		

MONTHLY DISCHARGE of Cache Creek, above diversions, for 1911.

(Drainage area, 35 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAIN-FALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	4·7	2·7	3·0	0·11	0·12	238	
July	2·7	1·0	1·7	0·05	0·06	105	
August	4·7	1·0	2·7	0·08	0·09	166	
The period							10

NOTE.—The station was maintained only during the irrigation season.
Accuracy "C."

DAILY GAUGE HEIGHT AND DISCHARGE of Cache Creek, above diversions, for 1912.

Day	April.		May.		June.		July.		August.		September.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft
1		2·7		35		9·0	0·8	3·5				
2	0·6	2·7		40	0·9	7·8		3·5				
3		2·7		45		7·8		3·5			0·8	3·5
4		2·7		49		7·8		3·5				
5		2·7		54		7·8		3·5				
6		2·7	1·6	59		7·8		3·5				
7		2·7		56		7·8		3·5				
8	0·6	2·7		54	0·9	7·8		3·5				
9		2·7		52		7·8		3·5				
10		2·7		50		7·8		3·5				
11		2·7		50		7·8		3·5				
12		2·7	1·5	48		7·8		3·5				
13		2·7		45		7·8		3·5	0·7	1·0		
14	0·6	2·7		42		7·8	0·8	3·5				
15		3·3		39	0·9	7·8		3·5				
16		3·9		36		7·0		3·5				
17		4·5		34		6·2		3·5				
18		5·0		32		5·4		3·5				
19		5·5	1·3	30		5·0		3·5				
20		6·1		28		4·6		3·5				
21	0·8	6·7		26		4·2	0·8	3·5				
22		8·3		24		3·8		3·5				
23		9·9		22	0·8	3·5		3·5				
24		11·5		20		3·5		3·5				
25		13·1		19		3·5		3·5				
26		14·7	1·1	18		3·5		3·5				
27		16·3		16		3·5	0·8	3·5				
28	1·1	18·0		15	0·8	3·5		3·5				
29		22·0		13		3·5		3·5				
30		28·0		12		3·5		3·5				
31				10				3·5				

MONTHLY DISCHARGE of Cache Creek, above diversions, for 1912.

(Drainage area, 35 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	2·8	2·7	7·1	0·2	0·22	422	
May	5·9	10	34·6	1·0	1·2	2,130	
June	9	3·5	6·1	0·18	0·2	363	
July	3·5	3·5	3·5	0·1	0·11	215	
The period							10

NOTE.—The station was maintained only during the irrigation season.

Cahilty Creek (244).

Cahilty creek is a tributary of Louis creek, in the North Thompson drainage, and is a torrential mountain stream, rising in the highest hills of the district at 7,000 feet, and dropping 5,000 feet to its junction with Louis creek. The snow remains on mount Tod at the head of Cahilty creek during ordinary years. The precipitation at the source is mostly in the form of snow, and its run-off occurs during the late spring. At the mouth of Cahilty creek the precipitation in an average year is about 20 inches. The water of Cahilty creek is used to a small extent for irrigation purposes, and there are excellent water-power posibilities, but no development has as yet been made.

Cahilty lake, some six miles from the mouth, affords excellent storage for the spring freshet. A narrow canyon through which the creek flows at the outlet of the lake could easily be dammed and a mean flow of from 25 to 35 second-feet procured.

The drainage area of Cahilty creek is well covered with British Columbia fir, bull-pine and balm of Gilead, with a few scattered spruce.

The station on Cahilty creek was established on August 17, 1911, by C. G. Cline, and weekly readings were taken to the end of October, 1911, and also from April 1 to October 31, 1912. It is located about a mile from the creek's mouth. The gauge is a standard vertical staff gauge 5 feet long, and is nailed to a 10-inch cottonwood on the left bank of the stream. Measurements are made by wading, about 175 feet below the gauge.

The velocity of the stream is very great, the banks are high and rocky, while the bed is rough. Just below the station the stream forks, and its waters join Louis creek at two different points about one-half a mile apart.

There are three bench-marks at the station on the right bank of Cahilty creek, whose elevations are referred to the gauge datum.

Discharge Measurements of Cahilty Creek, at mouth, for 1911.

Date	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
1911.							
Aug. 17..	C. G. Cline.	1046	12·0	6·7	0·7	0·93	5·0
Sept. 16..	"	1046	13·0	12·4	1·2	1·27	14·8
1912.							
April 30.....	C. G. Cline and E. M. Dann	1046	14·0	8·3	0·9	1·10	7·5
May 16.....	E. M. Dann.....	1046	21·0	37·7	4·8	2·20	183
Aug. 22.....	H. J. E. Keys.....	1057	16·0	12·2	1·3	1·30	16·0

DAILY GAUGE HEIGHT AND DISCHARGE of Cahilty Creek, at mouth, for 1911.

DAY.	AUGUST.		SEPTEMBER.		OCTOBER.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			2·0	2·0		6·9
2				2·0	1·1	7·0
3			0·8	2·0		6·3
4				2·2		5·7
5				2·5		5·2
6				2·7		4·7
7				3·0	0·95	4·2
8				3·2		4·3
9			0·9	3·5		4·4
10				5·1		4·5
11				6·7		4·6
12				8·3		4·7
13				9·9		4·8
14				11·5		4·9
15				13·0	1·0	5·0
16			1·27	14·5		4·5
17	0·9	3·5	1·2	11·0		4·0
18				10·2		3·6
19				9·5		3·2
20				8·8		2·8
21				8·1		2·4
22				7·4	0·8	2·0
23				6·7		2·0
24			1·05	6·0		2·0
25				6·1		2·0
26				6·2		2·0
27	0·8	2·0		6·3		2·0
28				6·4		2·0
29				6·5	0·8	2·0
30				6·7		2·0
31						2·0

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MONTHLY DISCHARGE of Cahilty Creek, at mouth, for 1911.

(Drainage area, 20 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
August	3·5	2·0					
September	14·5	2·0	6·6	·33	·37	393	
October	7·0	2·0	3·8	·19	·22	234	
The period							20

NOTE.—Station established on Cahilty creek August 17, 1911.
Accuracy, "A."

DAILY GAUGE HEIGHT AND DISCHARGE

DAY.	APRIL.		MAY.		JUNE.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		2·0		9·4		164
2		2·0		11·7		145
3		2·0		14·1	2·0	125
4		2·0		16·5		140
5		2·0	1·35	19·0		154
6		2·0		30·6		169
7		2·0		42·2		183
8		2·0		53·8		198
9		2·0		65·4	2·3	212
10	0·8	2·0		77·0		222
11		2·0		88·5		231
12		2·1	1·9	100·0		241
13		2·2		120·5		251
14		2·3		141·0		260
15		2·3		161·5		270
16		2·4	2·2	182·0	2·5	280
17		2·4		182·0		258
18		2·5		182·0		236
19		2·6	2·2	182·0		214
20		2·7		196·0		192
21	0·85	2·7		210·0		170
22		2·8		224·0		148
23		2·9		238·0	2·0	125
24		3·0		252·0		115
25		3·1		266·0		106
26		3·2	2·5	280·0		96
27		3·3		261·0		87
28		3·4		241·0		77
29	0·90	3·5		222·0		68
30	1·10	7·0		202·0	1·7	58
31				183·0		

of Cahilty Creek, at mouth, for 1912.

July.		August.		September.		October.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
1·7	58		14	1·5	30		8	1
	65		13		32		9	2
	72		12		34		9	3
	79	1·2	11		36		10	4
	86		14		38		10	5
	93		16		40	1·2	11	6
1·9	100		19		42		10	7
	92		22	1·6	43		10	8
	84		25		40		9	9
	76		27		37		9	10
	68	1·5	30		34		8	11
	60		28		31		8	12
	52		28		28	1·1	7	13
1·6	43		27		25		8	14
	38		26	1·4	22		8	15
	33		25		20		9	16
	29		23		18		9	17
	25	1·4	22		17		10	18
	20		21		16		10	19
1·3	16		20		14	1·2	11	20
	16		18		12		11	21
	17	1·3	16	1·2	11		10	22
	18		16		11		9	23
	19		16		10		8	24
	20	1·3	16		10		7	25
	20		18		9		6	26
	21		20		9	1·0	5	27
1·4	22		22		8		5	28
	20		24	1·1	7		5	29
	18		26		7		5	30
	16		28				5	31

MONTHLY DISCHARGE of Cahilty Creek, at mouth, for 1912.

(Drainage area, 20 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	7·0	2·0	2·6	·13	·15	155	
May	280	9·4	144	7·20	8·30	8,854	
June	280	58	173	8·65	9·65	10,294	
July	100	16	·45	2·25	2·59	2,767	
August	30	11	21	1·05	1·21	1,291	
September	43	7	23	1·15	1·28	1,368	
October	11	5	8·4	42	·48	516	
The period							25

NOTE.—Accuracy "A" and "B".

CAMPBELL CREEK (250 AND 251).

The right branch of Campbell creek rises in the Campbell meadows at an elevation of 3,000 feet and the left branch in Napier lake at an elevation of 2,200 feet; the stream discharges into the South Thompson at an elevation of 1,140 feet. Campbell creek is in the eastern portion of the Dry Belt, the annual precipitation at the mouth being from 8 inches to 10 inches, and at the head-waters from 12 inches to 15 inches. Campbell creek is a very contentious irrigation stream. The Hydrographic Survey has two stations on it—one at Todd's Corners and the other at the Campbell estate at the mouth—the latter for the purpose of making a study of seepage loss. A slight decrease in discharge is found between the two stations, a portion of the flow of Campbell creek joining Thompson river as underground water.

The upper reaches of the creek are well timbered with British Columbia fir, jack pine and spruce, and there are large lakes at the head of Campbell creek proper. These lakes are Trapp, Shumway and Napier. Their superficial area is large, and evaporation in this dry country is great. In the season of 1911 the run-off from these lakes was nil, all Campbell creek water coming down Scuittoe creek (the right branch of Campbell creek) from the Campbell meadows. The lakes are unreliable for storage purposes.

The Campbell estate holds the prior records on this stream and controls practically the whole flow of Campbell creek.

The Campbell estate has constructed a small dam on Campbell meadows, where water is stored and is used in the late summer for irrigation.

At the height of the irrigation season (June 7) the two diversions above the station at Todd's Corners were carrying 4·5 second-feet; at no time did they exceed this amount, which is about their mean flow for the irrigation season.

The daily flow of Campbell creek, especially in the late summer, is not the true normal discharge of the stream, but depends upon the artificial control of the storage reservoir.

The station at Todd's Corners (250) was established on May 27, 1911, by C. E. Richardson, and daily gauge readings were taken during the irrigation seasons of

1911 and 1912. It is located at the highway bridge on the Kamloops-Grand Prairie road.

The gauge is a 5-foot standard vertical staff gauge, and is in a pool at the right hand side of the stream just below the bridge. In high water, measurements of the flow are made from the bridge, and in low water, by wading below the bridge. The creek runs through a meadow, but the banks are well defined and there is no danger of overflow.

The station at the Campbell Estate (251) is at the mouth of a canyon one-quarter of a mile above the Kamloops-Ducks highway. The gauge is a standard vertical staff gauge securely wedged in the rocks at the right bank of the stream. Measurements are made by wading, the channel being well confined in high rocky banks, and the bed being very rough and rocky. Three bench-marks are located at each station and referred to the gauge datum.

DISCHARGE MEASUREMENTS of Campbell Creek, Todd's Corners, for 1911.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
1911.							
May 27	W. M. Carlyle	1044	11·0	11·2	2·0	1·84	21·9
May 27	C. E. Richardson	1048	14·0	21·1	1·0	1·84	21·4
May 27	C. G. Cline	1046	12·0	8·9	2·5	1·84	22·2
June 9	C. E. Richardson	1048	11·7	13·0	1·8	1·89	23·3
June 23	W. M. Carlyle	1044	10·0	9·0	1·3	1·47	11·7
July 9	" "	1044	8·5	5·0	1·1	1·16	6·4
July 28	" "	1044	4·5	1·6	1·3	0·86	2·1
Aug. 17	" "	1044	4·0	1·3	1·1	0·75	1·4
1912.							
May 26	E. M. Dann	1044	7·0	9·8	4·8	2·33	47·0
July 18	H. J. E. Keys	1057	7·5	2·9	1·3	0·81	3·7
July 23	" "	268	3·0	1·3	1·5	0·66	2·0

DAILY GAUGE HEIGHT AND DISCHARGE of Campbell Creek, at Todd's Corners, for 1911.

Day.	May.		June.		July.		August.		September.		October.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·78	20·0	1·10	4·7	0·8	1·6	0·65	1·0	0·6	0·8
2			1·79	20·3	1·08	4·4	0·85	1·9	0·65	1·0	0·6	0·8
3			1·78	20·0	1·05	4·0	0·85	1·9	0·65	1·0	0·6	0·8
4			1·84	21·9	1·05	4·0	0·8	1·6	0·62	0·9	0·6	0·8
5			1·81	20·9	1·05	4·0	0·8	1·6	0·62	0·9		
6			1·82	21·2	1·05	4·0	0·84	1·9	0·60	0·8		
7			1·86	22·5	1·06	4·1	0·91	2·4	0·60	0·8		
8			1·85	22·2	1·10	4·7	0·92	2·5	0·60	0·8		
9			1·86	22·5	1·15	5·4	0·85	1·9	0·62	0·9		
10			1·85	22·2	1·19	6·2	0·82	1·7	0·62	0·9		
11			1·80	20·6	1·15	5·4	0·82	1·7	0·60	0·8		
12			1·75	19·2	1·20	6·4	0·80	1·6	0·60	0·8		
13			1·70	17·8	1·12	5·0	0·80	1·6	0·61	0·8		
14			1·66	16·8	1·09	4·5	0·80	1·6	0·62	0·9		
15			1·59	15·1	1·06	4·1	0·75	1·3	0·62	0·9		
16			1·55	14·1	1·02	3·6	0·75	1·3	0·63	0·9		
17			1·52	13·4	0·98	3·1	0·74	1·3	0·62	0·9		
18			1·48	12·4	0·94	2·7	0·73	1·2	0·62	0·9		
19			1·45	11·8	0·90	2·3	0·73	1·2	0·6	0·8		
20			1·42	11·1	0·90	2·3	0·72	1·2	0·60	0·8		
21			1·44	11·5	0·90	2·3	0·7	1·1	0·60	0·8		
22			1·50	12·9	0·90	2·3	0·7	1·1	0·65	1·0		
23			1·41	10·8	0·90	2·3	0·73	1·2	0·62	0·9		
24			1·39	10·4	0·88	2·2	0·72	1·2	0·6	0·8		
25			1·35	9·4	0·86	2·0	0·72	1·2	0·6	0·8		
26			1·26	7·5	0·89	2·2	0·70	1·1	0·6	0·8		
27	1·83	21·6	1·24	7·2	0·87	2·1	0·70	1·1	0·6	0·8		
28	1·80	20·6	1·20	6·4	0·85	1·9	0·70	1·1	0·6	0·8		
29	1·82	21·2	1·21	6·6	0·85	1·9	0·67	1·0	0·6	0·8		
30	1·80	20·6	1·18	6·1	0·84	1·9	0·67	1·0	0·58	0·7		
31	1·79	20·3			0·80	1·6	0·67	1·0				

MONTHLY DISCHARGE of Campbell Creek, at Todd's Corners, for 1911.

(Drainage area, 200 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	22·5	6·1	15·2	·07	·08	905	
July	6·4	1·6	3·5	·02	·02	215	
August	2·5	1·0	1·5	·10	·01	95	
September	1·0	0·7	0·85	·004	·004	51	
The period							9

NOTE.—This station was not established till after the spring freshet of 1911. To the total run-off in acre-feet should be added 600 acre-feet, which quantity of water was diverted and used for irrigation by two small irrigation ditches whose headgates are situate above the gauging station, and whose flow was measured from time to time.

Accuracy, "A."

SESSIONAL PAPER No. 25f

DAILY GAUGE HEIGHT AND DISCHARGE of Campbell Creek, at Todd's Corners, for 1912.

DAY.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		2·6	0·76	1·4	2·03	32·2	1·49	15·1	0·68	2·3	0·86	3·6
2	0·93	2·6	0·76	1·4	1·94	28·9	1·36	12·1	0·68	2·3	0·83	3·4
3	0·9	2·3	0·76	1·4	1·79	23·7	1·36	12·1	0·66	2·7	0·81	3·2
4	0·86	2·0	0·78	1·5	1·66	19·7	1·34	11·6	0·66	2·2	0·81	3·2
5	0·8	1·6	0·73	1·2	1·63	18·8	1·31	10·9	0·88	3·8	0·78	3·0
6	0·78	1·5	0·76	1·4	1·61	18·3	1·29	10·5	0·93	4·4	0·78	3·0
7	0·77	1·4	0·88	2·2	1·58	17·5	1,24	9·5	0·91	4·1	0·76	2·9
8	0·76	1·4	0·93	2·6	1·54	16·4	1·21	8·9	0·88	3·8	0·76	2·9
9	0·76	1·4	0·98	3·1	1·46	14·4	1·21	8·9	0·88	3·8	0·76	2·9
10	0·76	1·4	1·03	3·7	1·41	13·2	1·19	8·5	0·86	3·6	0·76	2·9
11	0·76	1·4	1·68	17·3	1·41	13·2	1·11	7·2	0·83	3·4	0·73	2·7
12	0·76	1·4	1·83	21·6	1·41	13·2	1·11	7·2	0·81	3·2	0·73	2·7
13	0·73	1·2	2·06	29·9	1·43	13·7	1·09	6·8	0·78	3·0	0·73	2·7
14	0·73	1·2	2·26	39·8	1·49	15·1	1·08	6·7	0·78	3·0	0·71	2·6
15	0·73	1·2	2·11	31·9	1·51	15·6	1·06	6·3	0·76	2·9	0·71	2·6
16	0·73	1·2	2·17	35·0	1·51	15·6	1·04	6·0	0·76	2·9	0·66	2·2
17	0·73	1·2	2·23	38·1	1·51	15·6	0·97	4·9	0·76	2·9		
18	0·73	1·2	2·26	39·8	1·49	15·1	0·84	3·5	0·76	2·9		
19	0·72	1·2	2·36	45·6	1·49	15·1	0·71	2·6	0·81	3·2		
20	0·71	1·1	2·36	45·6	1·46	14·4	0·63	2·1	0·88	3·8		
21	0·71	1·1	2·27	40·3	1·41	13·2	0·61	2·0	0·96	4·8		
22	0·71	1·1	2·31	42·6	1·39	12·8	0·61	2·0	0·91	4·1		
23	0·71	1·1	2·31	42·6	1·36	12·1	0·68	2·3	0·88	3·8		
24	0·76	1·4	2·31	42·6	1·36	12·1	0·83	3·4	0·86	3·6		
25	0·71	1·1	2·36	45·6	1·23	9·3	0·91	4·1	0·86	3·6		
26	0·71	1·1	2·38	46·8	1·11	7·2	0·86	3·6	0·81	3·2		
27	0·71	1·1	2·39	47·5	1·71	21·1	0·81	3·2	0·83	3·4		
28	0·76	1·4	2·41	48·5	1·63	18·8	0·76	2·9	0·86	3·6		
29	0·76	1·4	2·41	48·5	1·46	14·4	0·76	2·9	0·87	3·7		
30	0·76	1·4	2·39	47·5	1·41	13·2	0·73	2·7	0·91	4·1		
31			2·29	42·6			0·71	2·6	0·86	3·6		

MONTHLY DISCHARGE of Campbell Creek, at Todd's Corners, for 1912.

(Drainage area, 200 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches
April	2·6	1·1	1·4	·005	·006	84	
May	48·5	1·2	27·7	·13	·15	1,703	
June	32·2	7·2	16·1	·08	·09	958	
July	15·1	2·0	6·2	·03	·03	381	
August	4·8	2·2	3·4	·017	·019	209	
The period							11

NOTE.—To the total run-off in acre-feet should be added 600 acre-feet, which quantity was diverted during the irrigation season through two small ditches, whose headgates are situate above the gauging station, and whose flow was measured from time to time.

Accuracy, "A."....

DISCHARGE MEASUREMENTS of Campbell Creek, above Campbell Estate diversion, for 1911 and 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
1911.							
June 7	C. E. Richardson	1048	17·0	8·5	1·8	1·62	15·5
June 23	W. M. Carlyle	1044	12·0	7·4	1·5	1·48	10·8
July 28	"	1044	4·8	1·8	0·7	1·11	1·3
Aug. 17	"	1044	5·0	1·7	0·5	1·06	0·9
1912.							
May 23	E. M. Dann	1044	15·0	14·5	2·0	1·85	29·4
May 26	"	1044	14·5	14·4	2·5	1·90	36·2
July 23	H. J. E. Keys	1057	2·5	0·6	4·3	1·20	2·7

DAILY GAUGE HEIGHT AND DISCHARGE of Campbell Creek, above Campbell Estate diversion, for 1911.

Day.	May.		June.		July.		August.		September.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·7	19·2	1·35	6·2	1·1	1·2	1·0	0·3
2			1·7	19·2	1·3	4·8	1·1	1·2	1·0	0·3
3			1·7	19·2	1·3	4·8	1·1	1·2	1·0	0·3
4			1·7	19·2	1·3	4·8	1·1	1·2	1·0	0·3
5			1·8	25·7	1·3	4·8	1·1	1·2	1·0	0·3
6			1·7	19·2	1·25	3·7	1·1	1·2	1·0	0·3
7			1·7	19·2	1·3	4·8	1·1	1·2	1·0	0·3
8			1·6	15·0	1·3	4·8	1·15	1·9	1·0	0·3
9			1·65	17·2	1·3	4·8	1·15	1·9	1·0	0·3
10			1·7	19·2	1·3	4·8	1·1	1·2	1·0	0·3
11			1·6	15·0	1·3	4·8	1·1	1·2	1·0	0·3
12			1·65	17·1	1·3	4·8	1·1	1·2	1·0	0·3
13			1·6	15·0	1·3	4·8	1·1	1·2	1·0	0·3
14			1·5	11·1	1·3	4·8	1·1	1·2	1·0	0·3
15			1·55	13·0	1·25	3·7	1·05	0·7	1·0	0·3
16			1·5	11·1	1·25	3·7	1·05	0·7	1·0	0·3
17			1·5	11·1	1·2	2·7	1·05	0·7	0·95	0·1
18			1·5	11·1	1·2	2·7	1·05	0·7	0·95	0·1
19			1·5	11·1	1·2	2·7	1·0	0·3	0·9	creek
20			1·5	11·1	1·2	2·7	1·0	0·3	0·9	dry
21			1·5	11·1	1·2	2·7	1·0	0·3	0·9	
22			1·5	11·1	1·15	1·9	1·0	0·3	0·9	
23			1·48	10·5	1·1	1·2	1·0	0·3	0·9	
24			1·45	9·4	1·1	1·2	1·0	0·3	0·9	
25	1·3	4·8	1·3	4·8	1·1	1·2	1·0	0·3	0·9	
26	1·5	11·1	1·3	4·8	1·1	1·2	1·0	0·3	0·9	
27	1·62	15·8	1·2	2·7	1·1	1·2	1·0	0·3	0·9	
28	1·65	17·1	1·3	4·8	1·1	1·2	1·0	0·3	0·9	
29	1·6	15·0	1·3	4·8	1·1	1·2	1·0	0·3	0·9	
30	1·65	17·1	1·3	4·8	1·1	1·2	1·0	0·3	0·9	
31	1·70	19·2			1·1	1·2	1·0	0·3		

SESSIONAL PAPER No. 25f

MONTHLY DISCHARGE of Campbell Creek, above Campbell Estate diversion, for 1911.
(Drainage area, 200 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAIN-FALL.
	Maximum	Minimum	Mean.	Per sq. mile	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	19·2	0	3·2	·02	·02	197	
June	25·7	2·7	12·9	·06	·07	768	
July	6·2	1·2	3·3	·02	·02	203	
August	1·9	0·3	0·8	·004	·005	49	
September	·3	0	0·2	·001	·001	12	
The period							9

NOTE.—Creek commenced to run at the Campbell Estate on May 25. It ran dry on September 19. Accuracy, "A."

GAUGE HEIGHT AND DAILY DISCHARGE of Campbell Creek, above Campbell Estate diversion, for 1912.

Day.	MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge Height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·9	34·8	1·6	15·0	1·1	1·2	1·1	1·2
2			1·7	19·2	1·5	11·1		1·2		1·2
3			1·6	15·0	1·5	11·1	1·1	1·2	1·1	1·2
4			1·6	15·0	1·5	11·1		1·2		1·2
5			1·6	15·0	1·5	11·1	1·1	1·2	1·1	1·2
6			1·6	15·0	1·5	11·1		1·2		1·2
7		creek	1·6	15·0	1·4	7·7	1·1	1·2	1·1	1·2
8		dry	1·6	15·0	1·4	7·7		1·2		1·2
9			1·6	15·0	1·3	4·8	1·1	1·2	1·0	0·3
10	1·2	2·7	1·6	15·0	1·3	4·8	1·1	1·2		0·3
11	1·4	7·7	1·6	15·0	1·3	4·8	1·1	1·2	1·0	0·3
12	1·65	17·1	1·6	15·0	1·3	4·8		1·2		0·3
13	1·7	19·2	1·6	15·9	1·3	4·8	1·1	1·2	1·0	0·3
14	1·8	25·7	1·6	15·0	1·3	4·8		1·2	1·0	0·3
15	1·8	25·7	1·6	15·0		3·7	1·1	1·2		
16	1·8	25·7	1·6	15·0	1·2	2·7		1·2		creek
17	1·9	34·8	1·6	15·0		2·7	1·1	1·2		dry
18	2·0	45·0	1·6	15·0	1·2	2·7	1·1	1·2		
19	1·8	25·7	1·6	15·0		2·7	1·1	1·2		
20	1·9	34·8	1·6	15·0	1·2	2·7	1·1	1·2		
21	1·9	34·8	1·6	15·0	1·2	2·7		1·2		
22	1·9	34·8	1·6	15·0	1·2	2·7	1·1	1·2		
23	1·9	34·8	1·6	15·0		2·7		1·2		
24	1·9	34·8	1·6	15·0	1·2	2·7	1·1	1·2		
25	1·9	34·8	1·6	15·0		2·7		1·2		
26	1·9	34·8	1·6	15·0	1·2	2·7	1·1	1·2		
27	1·9	34·8	1·9	34·8		2·0		1·2		
28	1·9	34·8	1·8	25·7	1·1	1·2	1·1	1·2		
29	1·9	34·8	1·7	19·2		1·2		1·2		
30	1·9	34·8	1·6	15·0	1·1	1·2	1·1	1·2		
31	1·9	34·8				1·2	1·1	1·2		

Monthly Discharge of Campbell Creek, Campbell Estate diversion, for 1912.

(Drainage area, 200 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	45·0	0	20·7	·10	·11	1,273	
June	34·8	15·0	16·9	·08	·09	1,006	
July	15·0	1·2	5·0	·02	·02	307	
August	1·2	1·2	1·2	·005	·006	74	
September	1·2	0	0·3	·001	·001	18	
The period							11

Note.—Creek commenced to run at the Campbell Estate on May 10. It ran dry on Sept. 14. Accuracy, "A."

Canoe Creek (310).

Canoe creek is a small stream, 8 miles long, rising in the hills 4 miles east of Salmon Arm, at an elevation of 1,500 feet, and discharging into Salmon Arm of Shuswap lake at Canoe station at an elevation of 1,150 feet, about 5 miles east of Salmon Arm. Its drainage area is 30 square miles, and the mean annual precipitation from 15 inches to 25 inches. It is a stream from 5 feet to 10 feet wide and from 6 inches to 1½ feet deep. It flows with an average velocity of 1½ miles an hour.

The East Fork, which rises in the Larch hills (elevation 3,000 feet) is 5 miles long and empties into Canoe creek about 3 miles from the mouth. This stream carries about 35 per cent of the water of Canoe creek, and it is from this that the municipality of Salmon Arm is obtaining (system now under construction) its water supply. Analysis shows that the water is ideal for drinking.

About one mile from its mouth, the East Fork disappears completely and comes to the surface again about half a mile from its mouth.

The maximum discharge of Canoe creek in 1912 was 35 second-feet, and took place on May 8. In January the discharge was as low as 2 second-feet. The yearly mean is about 6·5 second-feet.

The station was established by C. E. Richardson on June 2, 1911, and continuous readings were taken up to September, 1912. The measuring section is on the upstream side of the bridge on a blind road, one-half mile north of the main trunk road from Salmon Arm to Enderby. The gauge is a standard vertical staff gauge 5 feet long, and is located at the right end of the bridge, on the upstream side. Measurements are made from the bridge with wading equipment.

The banks of the creek are high and wooded, with no danger of overflow. The bed of the stream is of gravel, and the creek is confined to one channel. There are three bench-marks referred to the gauge datum.

SESSIONAL PAPER No. 25[illegible]

DISCHARGE MEASUREMENTS of Canoe Creek, near Salmon Arm, for 1911 and 1912.

Date.	Hydrographer.	Meter No.	Width	Area of section.	Mean velocity.	Gauge height.	Discharge.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
1911.							
June 3	G. E. Richardson	1048	7·5	10·2	1·4	2·0	14·6
June 12	" "	1048	7·5	6·2	1·3	1·76	8·1
June 26	" "	1048	7·5	5·5	0·9	1·48	4·9
Aug. 1	" "	1048	7·5	4·7	0·7	1·39	3·2
1912.							
May 19	H. G. Hughes	1048	8·0	14·6	1·4	2·55	20·8
June 14	C. E. Richardson.	1048	6·0	3·8	1·5	1·66	5·7
Sept. 6	" "	1047	7·0	3·7	1·0	1·5	3·6

* Different section.

Daily Gauge Height and Discharge of Canoe Creek, near Salmon Arm, 1911.

Day.	June.		July.		August.		September.		October.		November.		December.		Day.
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
1		13·0	1·55	4·9	1·40	3·3	1·42	3·5	1·60	5·5	1·60	5·5	1·58	5·2	1
2		13·0	1·52	4·6	1·40	3·3	1·42	3·5	1·60	5·5	1·60	5·5	1·58	5·2	2
3		13·0	1·50	4·2	1·40	3·3	1·42	3·5	1·60	5·5	1·62	5·9	1·58	5·2	3
4	1·95	13·0	1·45	3·7	1·40	3·3	1·50	4·2	1·60	5·5	1·65	6·2	1·58	5·2	4
5	1·90	11·5	1·45	3·7	1·40	3·3	1·50	4·2	1·60	5·5	1·70	7·1	1·58	5·2	5
6	1·90	11·5	1·42	3·5	1·42	3·5	1·50	4·2	1·60	5·5	1·68	6·6	1·58	5·2	6
7	1·88	10·8	1·42	3·5	1·55	4·8	1·50	4·2	1·60	5·5	1·70	7·1	1·58	5·2	7
8	1·85	10·1	1·72	7·5	1·45	3·7	1·50	4·2	1·60	5·5	1·70	7·1	1·58	5·2	8
9	1·80	9·0	1·72	7·5	1·42	3·5	1·50	4·2	1·62	5·9	1·62	5·9	1·55	4·8	9
10	1·80	9·0	1·68	6·6	1·42	3·5	1·50	4·2	1·62	5·9	1·62	5·9	1·55	4·8	10
11	1·80	9·0	1·68	6·6	1·42	3·5	1·50	4·2	1·65	6·2	1·65	6·2	1·52	4·5	11
12	1·78	8·4	1·55	4·8	1·42	3·5	1·50	4·2	1·68	6·6	1·65	6·2	1·52	4·5	12
13	1·72	7·4	1·52	4·5	1·42	3·5	1·60	5·5	1·68	6·6	1·62	5·9	1·52	3·5	13
14	1·70	7·1	1·50	4·2	1·42	3·5	1·60	5·5	1·70	7·1	1·60	5·5	1·52	4·5	14
15	1·65	6·2	1·45	3·7	1·42	3·5	1·60	5·5	1·70	7·1	1·60	5·5	1·52	4·5	15
16	1·58	5·2	1·45	3·7	1·42	3·5	1·60	5·5	1·70	7·1	1·60	5·5	1·52	4·5	16
17	1·55	4·8	1·45	3·7	1·42	3·5	1·60	5·5	1·68	6·6	1·60	5·5	1·52	4·5	17
18	1·52	4·5	1·42	3·5	1·40	3·3	1·60	5·5	1·68	6·6	1·60	5·5	1·52	4·5	18
19	1·50	4·2	1·42	3·5	1·40	3·3	1·60	5·5	1·65	6·2	1·62	5·9	1·52	4·5	19
20	1·50	4·2	1·42	3·5	1·48	4·0	1·60	5·5	1·65	6·2	1·60	5·5	1·52	4·5	20
21	1·45	3·7	1·42	3·5	1·42	3·5	1·60	5·5	1·65	6·2	1·60	5·5	1·52	4·5	21
22	1·60	5·5	1·42	3·5	1·42	3·5	1·60	5·5	1·62	5·9	1·60	5·5	1·52	4·5	22
23	1·50	4·2	1·42	3·5	1·42	3·5	1·60	5·5	1·62	5·9	1·60	5·5	1·52	4·5	23
24	1·50	4·2	1·40	3·3	1·42	3·5	1·60	5·5	1·62	5·9	1·60	5·5	1·50	4·2	24
25	1·50	4·2	1·40	3·3	1·42	3·5	1·60	5·5	1·62	5·9	1·62	5·9	1·50	4·2	25
26	1·45	3·7	1·40	3·3	1·42	3·5	1·60	5·5	1·62	5·9	1·60	5·5	1·50	4·2	26
27	1·60	5·5	1·40	3·3	1·42	3·5	1·60	5·5	1·62	5·9	1·60	5·5	1·50	4·2	27
28	1·55	4·8	1·40	3·3	1·42	3·5	1·60	5·5	1·62	5·9	1·60	5·5	1·50	4·2	28
29	1·50	4·2	1·40	3·3	1·42	3·5	1·60	5·5	1·60	5·5	1·60	5·5	1·47	4·0	29
30	1·45	3·7	1·40	3·3	1·42	3·5	1·60	5·5	1·60	5·5	1·60	5·5	1·47	4·0	30
31			1·40	3·3	1·42	3·5			1·60	5·5					31

MONTHLY DISCHARGE of Canoe Creek, near Salmon Arm, for 1911.

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	13·0	3·7	7·3	·24	·27	434	
July	7·5	3·3	4·1	·14	·16	252	
August	4·8	3·3	3·5	·11	·13	215	
September	5·5	3·5	4·9	·16	·18	292	
October	7·1	5·5	6·0	·20	·23	369	
November	7·1	5·5	5·8	·19	·21	345	
December	5·2	4·0	4·6	·15	·17	283	
The period							14

NOTE.—Ice conditions probably existed for very short periods during November and December. Since the figures given are for a discharge curve applicable only to conditions of open flow, the discharges given for these months may be slightly too large.

November and December, accuracy "C"; the other months, "B."

DAILY GAUGE HEIGHT AND DISCHARGE

DAY.	JANUARY.		FEBRUARY.		MARCH.		APRIL.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	1·45	3·2	1·38	2·6	1·5	3·7	1·6	4·8
2	1·48	3·5	1·38	2·6	1·5	3·7	1·65	5·4
3	1·50	3·7	1·38	2·6	1·5	3·7	1·7	6·0
4	1·55	4·2	1·35	2·4	1·5	3·7	1·75	6·7
5	1·53	4·0	1·35	2·4	1·48	3·5	1·78	7·1
6	1·50	3·7	1·33	2·3	1·48	3·5	1·78	7·1
7	1·45	3·2	1·38	2·6	1·45	3·2	1·8	7·4
8	1·40	2·8	1·43	3·0	1·45	3·2	1·85	8·2
9	1·40	2·8	1·45	3·2	1·43	3·0	1·9	8·9
10	1·40	2·8	1·45	3·2	1·43	3·0	2·0	10·5
11	1·38	2·6	1·45	3·2	1·4	2·8	2·1	12·3
12	1·38	2·6	1·45	3·2	1·4	2·8	2·2	14·1
13	1·35	2·4	1·48	3·5	1·4	2·8	2·3	16·0
14	1·35	2·4	1·48	3·5	1·4	2·8	2·38	17·6
15	1·33	2·3	1·5	3·7	1·4	2·8	2·38	17·6
16	1·33	2·3	1·5	3·7	1·4	2·8	2·38	17·6
17	1·33	2·3	1·53	4·0	1·4	2·8	2·38	17·6
18	1·30	2·1	1·55	4·2	1·4	2·8	2·4	18·0
19	1·30	2·1	1·55	4·2	1·4	2·8	2·4	18·0
20	1·30	2·1	1·53	4·0	1·4	2·8	2·4	18·0
21	1·30	2·1	1·53	4·0	1·4	2·8	2·4	18·0
22	1·30	2·1	1·53	4·0	1·4	2·8	2·4	18·0
23	1·33	2·3	1·5	3·7	1·4	2·8	2·43	18·6
24	1·33	2·3	1·5	3·7	1·4	2·8	2·6	22·0
25	1·35	2·4	1·5	3·7	1·45	3·2	2·6	22·0
26	1·38	2·6	1·5	3·7	1·50	3·7	2·6	22·0
27	1·38	2·6	1·5	3·7	1·55	4·2	2·6	22·0
28	1·4	2·8	1·5	3·7	1·6	4·8	2·6	22·0
29	1·4	2·8	1·5	3·7	1·6	4·8	2·7	24·0
30	1·4	2·8			1·58	4·5	2·8	26·0
31	1·4	2·8			1·58	4·5		

of Canoe Creek, near Salmon Arm, 1912.

May.		June.		July.		August.		September.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
2·8	26·0	1·85	8·2	1·4	2·8		2·5	.....	4·3	1
2·8	26·0	1·75	6·7	1·4	2·8	1·35	2·4	1·58	4·5	2
2·8	26·0	1·75	6·7	1·4	2·8		2·4		5·0	3
2·8	26·0	1·75	6·7	1·42	3·0		2·4	1·65	5·4	4
2·9	28·0	1·75	6·7	1·45	3·2	1·35	2·4		6·0	5
3·0	30·1	1·65	5·4	1·5	3·7		2·4	1·75	6·7	6
3·1	32·2	1·6	4·8	1·48	3·5	1·35	2·4	Gauge	readings	7
3·2	34·4	1·6	4·8	1·45	3·2		2·4	discon	tinued.	8
3·1	32·2	1·55	4·2	1·45	3·2	1·35	2·4			9
3·0	30·1	1·5	3·7	1·45	3·2		2·5			10
2·9	28·0	1·55	4·2	1·42	3·0		2·5			11
2·8	26·0	1·55	4·2	1·42	3·0	1·38	2·6			12
2·8	26·0	1·6	4·8	1·4	2·8		2·7			13
2·8	26·0	1·65	5·4	1·4	2·8	1·4	2·8			14
2·8	26·0	1·65	5·4	1·4	2·8		3·0			15
2·7	24·0	1·65	5·4		2·8	1·45	3·2			16
2·7	24·0	1·6	4·8	1·4	3·0		3·2			17
2·6	22·0	1·6	4·8		3·0		3·2			18
2·6	22·0	1·55	4·2	1·45	3·2	1·45	3·2			19
2·55	21·0	1·5	3·7		3·4		3·0			20
2·5	20·0	1·45	3·2		3·5	1·4	2·8			21
2·45	19·0	1·4	2·8	1·5	3·7		2·8			22
2·4	18·0	1·4	2·8		3·7	1·4	2·8			23
2·3	16·0	1·4	2·8	1·5	3·7		2·9			24
2·2	14·1	1·4	2·8		3·5		3·1			25
2·2	14·1	1·4	2·8	1·45	3·2	1·45	3·2			26
2·1	12·3	1·4	2·8		3·1		3·4			27
2·0	10·5	1·4	2·8		2·9	1·5	3·7			28
1·9	8·9	1·4	2·8	1·4	2·8	.....	3·9			29
1·85	8·2	1·43	3·0		2·7	1·57	4·0			30
1·85	8·2			1·38	2·6		4·2			31

MONTHLY DISCHARGE of Canoe Creek, near Salmon Arm, for 1912.

(Drainage area, 30 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
January	4·2	2·1	2·7	·09	·10	166	
February	4·2	2·3	3·4	·11	·12	196	
March	4·8	2·8	3·3	·11	·13	203	
April	26·0	4·8	15·1	·50	·56	898	
May	34·4	8·2	22·1	·74	·85	1,359	
June	8·2	2·8	4·4	·15	·17	262	
July	3·7	2·6	3·1	·10	·12	191	
August	4·2	2·4	2·9	·10	·12	178	
The period							16

NOTE.—Ice conditions probably existed for short periods during January and February. Since figures given are deduced from a discharge curve applicable only to conditions of open flow, the discharges for these months may be slightly too large.

January and February, Accuracy "C"; the other months, Accuracy "B."

CHARTRAND CREEK (259).

Chartrand creek (also called Jack creek) has its source on the plateau south of Kamloops lake at an elevation of 4,000 feet, and discharges into Guichon creek from the east, 6 miles above Mamit lake, at an elevation of 3,300 feet. It is part of the Guichon-Nicola-Thompson drainage. The drainage area, as measured from the Geological Survey map, dated 1895, scale 2 miles to an inch, is 25 square miles. Chartrand creek is an important irrigation stream in the Dry Belt; the summers are hot and dry, the winters long and very cold (–30° F.). There is no cultivation in the narrow valley of the creek, but the water is used in the Guichon valley. There are no storage facilities, but it would be practicable to divert the head-waters of the creek into the east fork of Three-mile creek for use in the Thompson valley. The creek is generally dry in the summer; in 1912, however, it ran about 2 second-feet all summer, and had a freshet in the spring of 75 second-feet for several days.

The river station of Chartrand creek was established September 16, 1911, by W. M. Carlyle, though no data were obtained until the spring of 1912. The measuring section is located at the bridge on the Kamloops-Mamit Lake road, about one-half mile from the mouth. A standard vertical staff gauge is located on the upstream side of the aforesaid bridge. The measurements were made by wading. This is a fair measuring section; the control is good, the banks high, the current uniform, though there is a possibility of the creek clogging during high water.

SESSIONAL PAPER No. 25f

DISCHARGE MEASUREMENTS of Chartrand Creek, near Mamit Lake, 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
May 14	H. J. E. Keys	1057	12·0	23·5	3·2	3·6	75·1
May 23	" "	1057	10·2	21·4	1·0	1·8	21·4
June 3	" "	1057	8·0	3·0	2·1	1·16	6·2
June 10	" "	1057	7·0	2·1	1·5	1·0	3·3
June 24	" "	1057	7·0	1·84	1·2	0·95	2·2
July 2	" "	1057	5·5	1·85	1·2	0·96	2·3
July 15	" "	1057	5·5	1·6	1·2	0·90	1·9
July 30	" "	1057	5·0	1·45	1·2	0·91	1·7
Aug. 16	" "	1057	4·5	0·96	1·1	0·83	1·1
Sept. 3	" "	1057	4·5	0·99	0·9	0·88	0·9
Sept. 6	" "	1057	4·0	0·77	0·9	0·85	0·7

GAUGE HEIGHT AND DISCHARGE of Chartrand Creek, near Mamit Lake, for 1912.

Day.	May.		June.		July.		August.		September.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1				7·0		1·0		1·4	0·8	0·3
2			1·2	6·5		1·0	0·9	1·4		0·7
3				6·0	0·85	0·9		1·4		1·0
4				5·5		1·5	0·9	1·4	0·9	1·4
5			1·12	5·0	0·95	2·1		1·4		1·4
6	1·8	21·0		4·4		1·8		1·4	0·9	1·4
7		43·0	1·05	3·7	0·9	1·4	0·9	1·4		0·8
8	3·3	65·0		3·4		1·4		1·2	0·8	0·3
9		68·0	1·02	3·2		1·4	0·85	0·9		0·3
10	3·5	72·0		3·1	0·9	1·4		0·9		0·3
11		73·0		3·0		1·4	0·85	0·9	0·8	0·3
12		74·0		3·0	0·9	1·4		0·9		0·3
13	3·6	75·0	1·0	2·9		1·4		0·9	0·82	0·3
14		78·0		2·9	0·9	1·4	0·85	0·9		0·4
15	3·8	82·0	1·0	2·9		1·4		0·9	0·80	0·5
16		65·0		3·3		1·4	0·85	0·9		0·6
17	2·8	49·0	1·05	3·7	0·9	1·4		1·7		0·7
18		35·0		3·3		1·4	0·97	2·4		0·8
19	1·8	21·0	1·0	2·9	0·9	1·4		1·8		0·9
20		20·6		2·6		1·4		1·2		1·0
21		20·2	0·97	2·4	0·9	1·4	0·82	0·5		1·0
22	1·75	19·7		2·4		1·4		1·0		1·1
23		19·0	0·97	2·4		1·4	0·9	1·4		1·2
24	1·7	18·3		2·1	0·9	1·4		1·4		1·3
25		15·8		1·8		1·4	0·9	1·4	0·9	1·4
26	1·5	13·3	0·9	1·4	0·9	1·4		1·4		1·4
27		12·5		1·2		1·1		1·4		1·4
28		11·7	0·87	1·1	0·85	0·9	0·9	1·4	0·97	1·4
29	1·4	10·9		1·1		0·7		1·2		1·2
30		9·2	0·87	1·1		0·6	0·87	1·1	0·87	1·1
31	1·25	7·5			0·9	1·4		0·7		

MONTHLY DISCHARGE of Chartrand Creek, near Mamit Lake, for 1912.

(Drainage area, 25 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	82·0	7·5	32·2	1·29	1·49	1·980	
June	6·5	1·1	3·2	·13	·15	190	
July	2·1	0·6	1·3	·05	·06	81	
August	2·4	0·7	1·2	·05	·06	76	
September	1·4	0·3	0·9	·03	·04	52	
The period							12 to 18.

NOTE.—Accuracy, "A."

CHASE CREEK (260).

Chase creek is just at the easterly limit of the Dry Belt. It rises in the hills south of South Thompson river at an elevation of about 3,500 feet and, flowing in a general northerly direction for about 16 miles, discharges into the South Thompson at the town of Chase in township 21-13-6.

Chase creek is about 25 feet wide and 3·5 feet deep at high water in May and June, with a mean velocity of about 4·5 feet per second. At low water it goes down from 2 to 5 c.f.s.

The mean annual precipitation is about 15 inches. The summers are hot and dry, and irrigation is necessary; the winters are not severe, with a light snowfall. The creek is generally frozen for two or three months during the winter.

The Adams River Lumber Company has installed a water supply and fire protection system from Chase creek, with an 8-inch main, situated about 1½ miles up the creek, at an elevation of 260 feet above the flat. Four-inch laterals from the main are used to serve the town of Chase.

There are twelve water records from Chase creek, totalling some 2,650 miners inches (74 c.f.s.). In addition to the above-mentioned water system, there is only one diversion ditch for irrigation purposes, used by Messrs. Chase, Carlin and O'Brien. This ditch carried generally from 10 to 15 c.f.s. during 1911 and 1912, using some 2,500 acre-feet in 1911 and 2,000 acre-feet in 1912. The supply from Chase creek is good, and there is no contention over water rights.

About 1½ miles upstream there are two distinct falls, less than 100 feet apart. These falls are 34 feet and 28 feet high, respectively (measured by aneroid). By constructing a small dam just above the upper falls, small pondage could be secured, and a head of 75 feet obtained. A power site is available at the foot of the falls. Owing to the low flow of the stream in the late summer and winter, only a small development is possible. At present the town of Chase obtains its electric light from the plant at the mill, and it is improbable that the power on Chase creek will be used in the near future.

A regular gauging station was established on this stream on June 1, 1911, by C.E. Richardson, and has been since maintained during the open season. The gauge is a standard vertical staff 5 feet long, and is fastened to the cribbing on the upstream side of the C.P.R. tracks near Chase station. Measurements are made from the traffic bridge (on the road to the station) during high water, and by wading at other stages.

The gauge is located below both the water supply and irrigation diversions so as to obtain the flow of the stream above the diversions; from 10 to 15 c.f.s should be added during the month of June, July and August. The existing conditions at the station tend to give accurate results.

Discharge Measurements of Chase Creek, near Chase, B.C., for 1911 and 1912.

Date	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.
1911.							
June 1	C. E. Richardson	1048	23·0	61·1	4·4	2·70	269*
June 13	"	1048	23·5	45·3	4·1	2·22	185*
June 29	"	1048	23·5	29·7	1·5	0·89	43*
Aug. 2	"	1048	21·0	19·2	0·5	0·20	10·3*
Aug. 31	"	1048	8·4	3·5	1·0	−0·23	3·5†
1912.							
May 18	"	1048	24	65·4	4·55	2·75	297
June 13	"	1048	24	47	2·7	1·71	127

*Measurements from bridge.
†Wading measurement at different station.

DAILY GAUGE HEIGHTS AND DISCHARGE of Chase Creek, near Chase, for 1911.

DAY.	JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	2·65	262·	·95	45·0	·18	9·60	— ·10	4·0	— ·15	3·4	— ·08	4·4
2	2·95	317·	·90	42·0	·20	10·0	— ·10	4·0	— ·12	3·8	— ·10	4·0
3	2·80	288·	·85	38·5	·18	9·6	— ·10	4·0	— ·10	4·0	— ·10	4·0
4	2·28	195·	·75	32·0	·15	9·0	— ·10	4·0	— ·08	4·4	— ·10	4·0
5	2·05	160·	·82	36·4	·15	9·0	— ·15	3·4	— ·30	2·0	— ·10	4·0
6	1·88	137·	·75	32·0	·10	8·0	— ·12	3·8	— ·28	2·2	— ·20	2·8
7	1·72	118·	·65	27·0	·12	8·4	— ·10	4·0	— ·20	2·8	— ·30	2·0
8	1·70	115·	1·20	64·0	·20	10·0	— ·05	5·0	— ·20	2·8	— ·25	2·4
9	1·68	112·	1·82	130·	·25	11·5	— ·05	5·0	— ·20	2·8	— ·20	2·8
10	1·78	124·	1·88	137·	·30	13·0	— ·05	5·0	— ·15	3·4		
11	1·80	127·	1·78	125·	·25	11·5	— ·05	5·0	— ·15	3·4		
12	1·98	150·	1·60	102·	·25	11·5	— ·02	5·6	— ·05	5·0		
13	2·20	184·	1·35	76·5	·25	11·5	— ·12	3·8	— ·10	4·0		
14	2·20	184·	1·16	60·8	·25	11·5	— ·20	2·8	— ·15	3·4		
15	2·10	168·	1·02	49·6	·15	9·0	— ·25	2·4	— ·15	3·4		
16	2·00	153·	·98	46·8	·10	8·0	— ·30	2·0	— ·20	2·8		
17	1·80	127·	·92	43·2	·10	8·0	— ·30	2·0	— ·25	2·4		
18	1·75	121·	·82	36·4	0·0	6·0	— ·30	2·0	— ·25	2·4		
19	1·48	89·0	·75	32·0	— ·10	4·0	— ·25	2·4	— ·20	2·8		
20	1·22	65·6	·68	28·2	·28	12·4	— ·20	2·8	— ·15	3·4		
21	1·12	57·6	·65	27·0	·25	11·5	— ·20	2·8	— ·10	4·0		
22	1·15	60·0	·60	25·0	·20	9·0	— ·20	2·8	— ·10	4·0		
23	1·15	60·0	·68	28·2	·20	9·0	— ·15	3·4	— ·10	4·0		
24	1·05	52·0	·62	25·8	·20	9·0	— ·15	3·4	— ·10	4·0		
25	·98	46·8	·58	24·2	·20	9·0	— ·15	3·4	— ·10	4·0		
26	·98	46·8	·52	21·8	·20	10·0	— ·20	2·8	— ·05	5·0		
27	1·02	49·6	·48	20·2	— ·20	2·8	— ·20	2·8	— ·05	5·0		
28	·98	46·8	·38	16·2	— ·18	3·0	— ·20	2·8	— ·05	5·0		
29	·98	46·8	·32	13·8	— ·12	3·8	— ·18	3·0	— ·05	5·0		
30	·95	45·0	·32	13·8	— ·10	4·0	— ·12	3·8	— ·05	5·0		
31			·28	12·4	— ·10	4·0			— ·05	5·0		

SESSIONAL PAPER No. 25f

MONTHLY DISCHARGE of Chase Creek, near Chase, B.C., for 1911.

(Drainage area, 100 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	317	45	124	1·24	1·38	7379	
July	137	12·4	46	0·46	0·53	2804	
August	13	2·8	8·6	0·08	0·09	529	
September	5·6	2·0	3·5	0·03	0·03	208	
October	5·0	2·0	3·7	0·04	0·05	227	
The period							18

NOTE.—To the quantity of water in acre-feet should be added 2,500 acre-feet diverted above the gauging station and used for irrigation from May 1 to the end of August. Winter conditions set in on November 10.

Accuracy, "A."

DAILY GAUGE HEIGHTS AND DISCHARGE

DAY.	MARCH.		APRIL.		MAY.		JUNE.		JULY.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	0·30	14·0	0·05	7·2	2·0	155	1·97	152·0	0·40	17·0
2	0·30	14·0	0·05	7·2	1·92	147	1·85	137·0	0·40	17·0
3	0·25	12·5	0·07	7·6	2·00	155	1·77	127·0	0·47	19·8
4	0·27	13·1	0·10	8·0	2·10	170	1·72	122·0	0·72	32·2
5	0·32	14·6	0·10	8·0	2·07	165	1·60	105·0	0·92	44·4
6	0·37	16·1	0·12	8·6	2·25	192	1·60	105·0	0·97	47·9
7	0·45	19 0	0·15	9·5	2·42	223	1·60	105·0	1·00	50·0
8	0·50	21·0	0·20	11·0	2·72	285	1·57	102·3	1·02	51·6
9	0·45	19·0	0·22	11·6	2·92	335	1·55	100·0	1·00	50·0
10	0·40	17·0	0·32	14·6	2·95	342	1·50	96·0	1·05	54·0
11	0·37	16·1	0·52	22·0	2·67	273	1·50	96·9	1·00	50·0
12	0·40	17·0	0·77	35·2	2·62	260	1·55	100·0	0·87	41·2
13	0·40	17·0	0·95	46·5	2·67	273	1·72	122·0	0·65	28·5
14	0·35	15·5	1·07	55·6	2·85	317	1·77	127·0	0·57	24·5
15	0·35	15·5	1·07	55·6	3·25	435	1·87	140·0	0·50	21·0
16	0·30	14·0	1·12	59·8	3·40	485	2·02	158·0	0·42	17·8
17	0·35	15·5	1·20	67·0	3·20	420	2·00	155·0	0·32	14·6
18	0·30	14·0	1·27	73·3	2·72	285	1·85	137,0	0·30	14·0
19	0·30	14·0	1·35	81·0	2·52	239	1·67	115·0	0·27	13·1
20	0·25	12·5	1·40	86·0	2·15	177	1·37	83·0	0·20	11·0
21	0·25	12·5	1·52	97·8	2·25	192	1·05	54·0	0·20	11·0
22	0·20	11·0	1·57	102·3	2·37	214	0·87	41·2	0·25	12·5
23	0·13	8·9	1·60	105·0	2·67	273	0·80	37·0	0·27	13·1
24	0·10	8·0	1·67	115·	3·20	420	0·87	41·2	0·30	14·0
25	0·05	7·2	1·80	130·	3·15	402	0·72	32·2	0·25	12·5
26	0·03	7·0	1·82	133·	3·00	355	0·60	26·0	0·20	11·0
27	−0·05	5·7	1·80	130·	2·90	330	0·57	24·5	0·17	10·1
28	−0·05	5·7	1·85	137·	2·72	285	0·52	22·0	0·15	9·5
29	−0·10	5·0	1·95	150·	2·50	235	0·50	21·0	0·15	9·5
30	−0·10	5·0	2·02	158·	2·20	185	0·42	17·8	0·15	9·5
31	−0·10	5·0			2·05	162			0·15	9·5

SESSIONAL PAPER No. 25f

of Chase Creek, near Chase, B.C., for 1912.

August.		September.		October.		November.		December.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
0·10	8·0	0·0	6·5	0·2	3·5	0·1	8·0	0·1	8·0	1
0·10	8·0	·15	9·5	− 0·2	3·5	0·1	8·0	0·1	8·0	2
0·07	7·5	·45	19·0	− 0·2	3·5	0·1	8·0	0·1	8·0	3
0·05	7·2	·47	19·8	− 0·2	3·5	0·08	7·7	0·1	8·0	4
0·0	6·5	·42	17·8	− 0·2	3·5	0·05	7·2	·05	7·2	5
− ·10	5·0	·40	17·0	− 0·2	3·5	0·0	6·5	− 0·05	5·8	6
− ·20	3·5	·40	17·0	− 0·2	3·5	0·0	6·5	− 0·2	3·5	7
− ·20	3·5	·65	28·5	− 0·2	3·5	0·0	6·5	Freeze up.		8
− ·20	3·5	·75	34·0	− 0·2	3·5	− 0·1	5·0			9
− ·20	3·5	·62	27·0	− 0·2	3·5	− 0·1	5·0			10
− ·20	3·5	·60	26·0	− 0·2	3·5	− 0·1	5·0			11
− ·25	2·7	·57	24·5	− 0·2	3·5	− 0·1	5·0			12
− ·25	2·7	·47	19·8	− 0·2	3·5	− 0·1	5·0			13
− ·25	2·7	·27	13·1	− 0·2	3·5	− 0·1	5·0			14
− ·25	2·7	·20	11·0	− 0·2	3·5	− 0·05	5·8			15
− ·25	2·7	·15	9·5	− 0·2	3·5	− 0·05	5·8			16
− ·25	2·7	·10	8·0	− 0·1	5·0	− 0·1	5·0			17
·15	9·5	·07	7·5	− 0·2	11·0	0·1	5·0			18
·10	8·0	·02	6·8	− 0·2	11·0	− 0·1	5·0			19
·0	6·5	− ·05	5·7	− 0·2	11·0	0	6·5			20
− ·05	5·7	− ·12	4·7	− 0·2	11·0	0·1	8·0			21
− ·15	4·2	− ·15	4·3	− 0·2	11·0	0·1	8·0			22
− ·20	3·5	− ·15	4·3	− 0·2	11·0	0·1	8·0			23
− ·25	2·7	− ·17	4·0	− 0·2	11·0	0·1	8·0			24
− ·25	2·7	− ·20	3·5	− 0·15	9·5	0·1	8·0			25
− ·25	2·7	− ·20	3·5	− 0·15	9·5	0·1	8·0			26
− ·25	2·7	− ·20	3·5	− 0·1	8·0	0·0	6·5			27
− ·25	2·7	− ·22	3·2	− 0·1	8·0	0·0	6·5			28
− ·25	2·7	− ·25	2·7	− 0·1	8·0	0·05	7·2			29
− ·17	4·0	− ·25	2·7	− 0·1	8·0	0·1	8·0			30
0·0	6·5			− 0·1	8·0					31

Monthly Discharge of Chase Creek, near Chase, B.C., for 1912.

(Drainage area, 100 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
March	21·	5·	12·7	·12	·14	781·	
April	158	7·2	64	·64	·71	3830	
May	485	147·0	270	2·70	3·10	16600	
June	158	17·8	90·	·90	1·00	5350	
July	54·	9·5	24·	·24	·26	1470	
August	9·5	2·7	4·5	·04	·05	277	
September	34·	2·7	12·1	·12	·13	720	
October	11·	3·5	6·4	0·06	0·07	393	
November	8·	5·0	6·6	0·07	0·07	393	
The period							20

Note.—To the quantity of water in acre-feet should be added 2,000 acre-feet diverted above the gauging station and used for irrigation in May, June, July and part of August.
Accuracy, "A."

Chehalis River (117).

Chehalis river has its source in Chehalis lake, at an elevation of 700 feet and discharges into Harrison river near Harrison Mills, at an elevation of between 30 and 40 feet. It is part of the Harrison-Fraser drainage; the drainage area, as measured from the Railway Belt map, dated January 1, 1911, scale 7·89 miles per inch, is 200 square miles. The annual precipitation is about 80 to 90 inches; there is a very heavy snowfall in winter in all except the lowest parts of the watershed, and the winter conditions are fairly severe. At the mouth, however, the stream is open all the year round. Chehalis river, from its source in a rough mountainous country, flows through a wide valley, containing very fine timber, to Chehalis lake. Stadia creek, after tumbling over a 200-foot bluff, enters from the west in this valley. Chehalis lake is a deep mountain lake about seven miles long, with rocky cliffs rising from the water's edge. It is an excellent storage site for power purposes. The lake is well stocked with fish. At the lower end of the lake there is a canyon; dams could be constructed at several points in the canyon. Five miles below the lake, the west fork or Statlu creek enters from the west, a flashy stream, without a lake to control it.

For the last mile or so of its course, the Chehalis flows through a delta, and splits up into a number of sections, with frequent changes of its channel. The deposits from the Chehalis are gradually filling up Harrison bay, and at low water in Harrison river very extensive flats are exposed. The flow from Harrison lake through Harrison river is largely controlled by the bar which the Chehalis has formed across the Harrison; Harrison river rises and falls with the Fraser, and during low water this bar at the mouth of the Chehalis is a great hindrance to navigation and logging on Harrison river, which is the connecting link between 30 miles of navigation on Harrison lake and the Fraser.

To reach the Chehalis river it is necessary to go by water either from Harrison Mills or Harrison Hot Springs; there are no good roads yet, though one has been

surveyed. From the mouth of the river, there is an old logging road for five miles to an abandoned camp at Boulder creek. This road has been repaired sufficiently to serve as a pack trail, and has recently been extended to Chehalis lake.

The Chehalis valley was surveyed by A. W. Johnston in 1903, while he was locating the north boundary of the Railway Belt, but with the exception of two ranches on the delta, there is no settlement. The river, at present, used for lumbering only, is being investigated by engineers as to its power possibilities; there is a 650-foot head in 11 miles, with an excellent storage reservoir in Chehalis lake. The river station was established November 4, 1911, by C.G. Cline. It is located one mile from the mouth, opposite the foot of the first hill on the trail up the river. A chain gauge, supported from a pole fastened to two ties, is located on the right bank; its datum is referred to three bench-marks. Measurements are made by wading, except at high water, when cable measurements are made from a canoe one-quarter mile below the gauge. The measuring section is fair; the control is good, the banks high on one side, current uniform, and one channel at low water. At high water, however, the river overflows its left bank and forms two channels. The bed of the stream is liable to cut and shift, especially during the freshet.

The power possibilities of Chehalis river are being investigated by the Vancouver Power Company. The C.P.R. has also made application for power privileges on the river.

DISCHARGE MEASUREMENTS of Chehalis River, one mile from mouth, for 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
1911.							
Dec. 11.....	K. H. Smith	1057	101	273	3·7	3·8	1,021
1312.							
Mar. 8.....	C. G. Cline	1046	110	162	1·82	2·7	295
July 5	"	1046	123	221	2·4	3·07	535
Sept. 11.....	"	1046	105	248	2·4	2·9	594
Nov. 23.....	"	1048	140	600	4·8	1·95	2·910
Dec. 4	"	1048	130	343	3·6	3·92	1220

DAILY GAUGE HEIGHTS AND DISCHARGE of Chehalis River, one mile from mouth, for 1911.

Day.	NOVEMBER.		DECEMBER.	
	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		290	4·8	2,620
2		290	4·55	2,160
3		290	4·3	1,760
4	2·65	290	4·2	1,610
5	2·05	290	4·25	1,685
6	3·9	1,210	4·6	2,250
7	4·7	2,430	4·55	2,160
8	4·35	1,835	5·7	4,550
9	3·4	730	5·2	3,430
10	3·2	580	4·9	2,820
11	3·1	520	4·8	2,620
12	2·9	410	4·5	2,070
13	2·8	360	4·2	1,610
14	2·8	360	3·9	1,210
15	2·85	385	3·8	1,100
16	5·3	3,640	3·7	990
17	5·8	4,780	3·5	810
18	7·8	9,500	3·6	900
19	5·4	3,860	4·0	1,330
20	5·8	4,780	3·65	945
21	5·5	4,090	3·5	810
22	5·25	3,555	3·8	1,100
23	4·8	2,620		1,000
24	4·55	2,160		1,000
25	6·0	5,250		1,000
26	5·05	3,120		1,000
27	4·75	2,525		1,000
28	4·3	1,760		1,000
29	4·05	1,400		1,000
30	4·4	1,910		1,000
31				1,000

MONTHLY DISCHARGE of Chehalis River, one mile from mouth, for 1911.

(Drainage area, 200 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage. area.	Total in acre-feet.	Inches.
November	9,500	290	2,173	10·8	12·0	129,000	
December	4,550	810	1,598	8·0	9·2	98,200	
The period							70

NOTE.—Accuracy, "B."

DAILY GAUGE HEIGHT AND DISCHARGE of

Day.	MARCH.		APRIL.		MAY.		JUNE.		JULY.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	...	...	2·8	360	3·21	587	3·51	819	3·13	538
2	...	...	2·8	360	3·11	526	3·36	698	3·14	544
3	...	...	3·01	466	3·11	526	3·31	658	3·14	544
4	...	...	2·91	415	3·12	532	3·32	666	3·15	550
5	...	...	2·92	420	3·07	502	3·32	666	3·15	550
6	...	...	2·92	420	3·12	532	3·27	629	3·16	556
7	2·7	310	2·98	450	3·43	754	3·28	36	3·11	526
8	2·6	270	2·98	450	3·73	1,023	3·33	674	2·97	445
9	2·6	270	3·03	478	3·83	1,152	3·33	674	2·87	395
10	2·5	240	3·04	484	3·74	1,034	3·34	682	2·88	400
11	2·4	210	3·04	484	3·64	936	3·44	762	2·88	400
12	2·4	210	3·04	484	3·64	936	3·64	936	2·94	430
13	2·35	200	3·05	490	3·75	1·045	3·95	1,270	3·10	520
14	2·37	204	2·95	435	3·85	1,155	3·75	1,045	3·00	460
15	2·37	204	3·05	490	3·95	1,270	3·65	945	3·10	520
16	2·37	204	2·96	440	3·81	1,111	3·66	954	3·05	490
17	2·42	216	3·01	466	3·66	954	3·56	864	2·9	410
18	2·53	249	3·01	466	3·46	778	3·37	706	2·7	310
19	2·53	249	3·02	472	3·47	786	3·37	706	2·55	255
20	2·44	222	3·02	472	3·67	963	3·38	714	2·5	240
21	2·44	222	2·87	395	3·82	1,122	3·58	882	2·5	240
22	2·40	210	2·68	302	3·78	1,078	3·69	981	2·5	240
23	2·35	200	2·68	302	3·68	972	3·49	802	2·55	255
24	2·36	202	2·68	302	3·68	972	3·40	730	2·7	310
25	2·46	228	2·69	306	3·59	891	3·20	580	2·7	310
26	2·57	261	2·79	355	3·59	891	3·21	587	2·7	310
27	2·67	298	2·79	355	3·59	891	3·31	658	2·6	270
28	2·73	325	2·80	360	3·85	1,155	3·32	666	2·6	270
29	2·73	325	2·90	410	3·70	990	3·22	594	2·5	240
30	2·79	355	3·30	650	3·70	990	3·23	601	2·45	225
31	2·74	330	...	...	3·70	990	...	...	2·4	210

Chehalis River, one mile from mouth, for 1912.

August.		September.		October.		November.		December.		Day.
Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
2·4	210	4·0	1,330	1·9	135	3·3	650	4·3	1,760	1
2·35	200	3·9	1,210	1·9	135	3·2	580	4·8	2,620	2
2·3	190	3·6	900	2·0	145	3·15	550	4·4	1,910	3
2 3	190	3·5	810	2·0	145	3·2	680	3·9	1,210	4
2·3	190	3·4	730	2·0	145	3·4	730	3·7	990	5
2·2	175	3·25	615	2·2	175	4·5	2,070	3·5	810	6
2·15	167	3·2	580	2·4	210	4·2	1,610	3·3	650	7
2·1	160	3·3	650	3·0	460	4·0	1,330	3·1	520	8
2·2	175	3·1	520	2·7	310	3·85	1,155	3·0	460	9
2·6	270	2·9	410	2·6	270	3·8	1,100	2·9	410	10
2·7	310	2·8	360	2·5	240	4·0	1,330	3·05	490	11
2·6	270	2·75	335	2·45	225	4·1	1,470	3·0	460	12
2·5	240	2·7	310	2·4	210	6·0	5·250	4·0	1,330	13
2·5	240	2·6	270	2·5	240	5·0	3,020	3·8	1,100	14
2·7	310	2·6	270	2·7	310	4·55	2,160	2·8	360	15
3·3	650	2·4	210	3·4	730	4·3	1,760	2·9	410	16
3·2	580	2·3	190	4·2	1,610	4·2	1,610	4·0	1,330	17
3·0	460	2·25	182	3·9	1,210	5·0	3,020	4·2	1,610	18
2·8	360	2·25	182	4·1	1,470	6·0	5,250	3·9	1,210	19
2·7	310	2·2	175	3·8	1,100	5·9	5,010	3·7	990	20
2·5	240	2·2	175	3·7	990	6·1	5·500	3·6	900	21
2·5	240	2·2	175	3·5	810	5·4	3,860	3·35	690	22
2·5	240	2·1	160	3·5	810	4·85	2,720	3·4	730	23
2·5	240	2·05	152	3·6	900	4·95	2,920	3·4	730	24
2·5	240	2·0	145	4·1	1,470	4·6	2,250	3·5	810	25
2·4	210	1·9	135	3·9	1,210	4·3	1,760	3·55	855	26
2·35	200	1·9	135	3·6	900	4·05	1,400	3·7	990	27
2·25	182	1·9	135	3·5	810	3·9	1,210	4·0	1,330	28
2·4	210	1·9	135	3·5	810	3·75	1,045	3·9	1,210	29
2·8	360	1·8	130	3·4	730	3·6	900	3·8	1,100	30
4·2	1,610	.....	.....	3·3	650	.....	.....	3·7	990	31

MONTHLY DISCHARGE of Chehalis River, one mile from mouth, for 1912.

(Discharge area, 200 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
March	355	200	248	1·2	1·4	15,250	
April	650	302	425	2·1	2·3	25,300	
May	1,270	502	904	4·5	5·2	55,600	
June	1,270	580	760	3·8	4·2	45,200	
July	556	210	386	1·9	2·2	23,700	
August	1,610	160	310	1·5	1·7	19,060	
September	1,330	130	390	1·9	2·1	23,200	
October	1,610	135	631	3·1	3·6	38,800	
November	5,250	550	2,127	10·6	11·8	126,500	
December	2,620	410	999	5·0	5·8	61,400	
The period							70

NOTE.—See also miscellaneous measurements on Chehalis River, just below Chehals Lake. Open conditions exist all year.

Accuracy, "A" and "C."

CHERRY CREEK.

Cherry creek has its source in the hills south of Kamloops lake, at an elevation of 3,800 feet, and discharges into Kamloops lake, at an elevation of 1,120 feet. It is part of the Thompson drainage; the drainage area, as measured from the Geological Survey map, dated 1895, scale 2 miles to an inch, is 70 square miles; of this area 33 square miles is above the gauge. Cherry creek has the following tributaries: Alkali creek, entering from the left; Dairy and Pendleton creeks, entering from the right going upstream. Cherry creek, as well as its tributaries, is situated in the most arid section of the Dry Belt; the summers are hot and dry, the winters long and cold (—20 F.); the precipitation varies from 8 inches, near the mouth, to 12 inches at the headwaters.

Cherry creek is a contentious irrigation stream about 12 miles long. The upper 6 miles consists of dry range hills with little irrigable land, but the lower half of the stream flows through wide benches, which only require water to become fertile agricultural lands. In a wet season like 1912, the creek will run for six or seven months at the station; in a dry season the stream cannot be depended on for more than three months, and then for a mean discharge of only 2 second-feet. In different sections of the stream conditions are different; near the mouth the creek runs all year; in other places the stream will be absolutely dry, while running a hundred yards above and below. Apparently there is a large amount of seepage in proportion to the size of the stream. This fact makes the measurement of the discharge very difficult.

Cherry creek has excellent storage facilities in the following lakes, situated near the head-waters of the creek: Big Meadow reservoir, with a capacity of 1,250 acre-feet; Chuwhels lake, with a capacity of 525 acre-feet; Roper lake, with a capacity of 225 acre-feet; Andrew lake and Cornwall lake, which have not been dammed as yet. These lakes, however, are so far upstream that their catchment basins are small, and only a little water can be conserved, the reservoirs rarely filling to their capacity. Cherry creek is greatly over-recorded; the many records on the creek call for over 4,400 miner's inches, or over 120 second-feet; while the mean flow of recent years has

been less than 10 second-feet during the whole irrigation season. To further increase the water supply of the Cherry Creek district, records were taken out by Cherry-Creek interests to divert water from Big Fish, and Face lakes, which lakes are part of the Guichon drainage area flowing southerly into the Nicola district. It is proposed to divert the water of these lakes across the divide, and in a northerly direction to the Beaton and Cherry Creek estates. (For further information see remarks on Greenstone creek.) On May 15, during the freshet, the storage dam on Chuwhels lake failed, and washed out the gauge. The channel, too, was entirely altered.

The river station on Cherry Creek was established June 5, 1911, by W. M. Carlyle. The measuring section is located above all diversions, on the Kensington ranch, just beside the gauge. The gauge is fastened about 100 feet above the Cornwall diversion, on the right bank. This gauge was washed out by the above mentioned dam failure, and a temporary one was located to complete the year 1912. All the measurements are made by wading. This would make an excellent measuring section, but for the possibility of seepage. The control is good, the current uniform, the banks high: and there is only one channel. The datum of the gauge is referred to three bench-marks.

DISCHARGE MEASUREMENTS of Cherry Creek, at Cornwall's ranch, for 1911 and 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
1911.							
June 5	W. M. Carlyle	1044	10·0	5·95	1·29		7·0
" 21	"	1044	9·0	4·4	0·9		4·0
July 21	"	1044	2·4	1·0	0·3		0·3
1912.							
April 24	H. J. E. Keys	1057	8·0	5·0	0·3	0·6	1·5
May 8	"	1057	10·0	13·0	5·7	2·2	74·0
" 17	"	1057	10·0	16·0	4·3	2·8	69·0*
" 25	"	1057	11·5	7·0	3·8	2·12	27·4
" 28	"	1057	9·0	6·0	3·1	1·90	19·7
June 13	"	1057	7·5	2·6	1·50	1·20	4·0
" 26	"	1057	2·0	0·5	1·0	1·10	0·5
July 4	"	1057	7·0	2·8	1·4	1·60	4·1
" 11	"	1057	6·5	2·5	1·5	1·61	3·7
" 21	"	1057	6·2	1·8	1·1	1·50	2·0
Aug. 1	"	1057	4·0	1·1	1·5	1·46	1·7
" 9	"	1057	8·0	4·4	2·7	1·80	12·0
" 27	"	1057	3·0	0·6	1·0	1·40	0·6

* New Gauge. Old one washed out on May 15, when dam on Chuwhels Lake went out. The channel was so altered that a new discharge curve had to be made.

DAILY GAUGE HEIGHTS AND DISCHARGE of Cherry Creek at Cornwall's Ranch for 1911.

Day.	JUNE.		JULY.		AUGUST.	
	Gauge height.	Discharge.	Guage height.	Discharge.	Guage height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·6	1·86	0·4	0·26
2			0·6	1·86	0·38	0·23
3			0·55	1·36	0·38	0·23
4			0·56	0·86	0·38	0·23
5	1·0	9·43	0·48	0·74	0·38	0·23
6	0·9	7·06	0·48	0·74	0·38	0·23
7	1·0	9·43	0·45	0·56	0·38	0·23
8	0·85	0·03	0·45	0·56	0·4	0·26
9	0·85	6·03	0·45	0·5,	0·4	0·26
10	0·8	5·00	0·45	0·56	0·38	0·23
11	0·9	7·06	0·45	0·56	0·36	0·19
12	1·0	9·43	0·45	0·56	0·36	0·19
13	0·9	7·06	0·42	0·38	0·35	0·17
14	0·85	6·03	0·42	0·38	0·35	0·17
15	0·9	7·06	0·42	0·38	0·32	0·12
16	0·85	6·03	0·42	0·38	0·32	0·12
17	0·85	6·03	0·42	0·38	0·32	0·12
18	0·85	6·03	0·42	0·38	0·3	0·08
19	0·8	5·00	0·42	0·38	0·3	0·08
20	0·75	4·11	0·4	0·26	0·3	0·08
21	0·75	4·11	0·4	0·26	0·3	0·08
22	1·0	9·43	0·4	0·26	0·3	0·08
23	0·7	3·22	0·4	0·26	0·28	0·07
24	0·65	2·54	0·4	0·26	0·28	0·07
25	0·65	2·54	0·4	0·26	0·25	0·05
26	0·65	2·54	0·4	0·26	0·25	0·05
27	0·62	2·13	0·4	0·26	0·2	0·02
28	0·62	2·13	0·4	0·26	0·15	0·00
29	0·62	2·13	0·4	0·26	0·15	0·00
30	0·62	2·13	0·4	0·26	0·1	0·00
31			0·4	0·26	0·0	0·00

MONTHLY DISCHARGE of Cherry Creek, at Cornwall's Ranch, for 1911.

(Drainage area, 33 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	9·43	2·13	5·5	0·17	0·2	327·3	
July	1·86	0·26	0·53	0·016	0·02	32·5	
August	0·26	0·00	0·13	0·004	0·004	8·0	
The period							9

NOTE.—Entire drainage area, Cherry creek, is 70 square miles, and 33 square miles represents drainage area above gauge. Station established on June 5, after the maximum flood was over. The creek became dry about the end of August. The year 1911 was a dry year, the run-off of Cherry Creek district being smaller than the average. The flow is controlled by several storage reservoirs near the head of the creek.

Accuracy, "B."

DAILY DISCHARGE of Cherry Creek, at Cornwall's Ranch, for 1912.

Day.	APRIL.	MAY.	JUNE.	JULY.	AUGUST.	SEPTEMBER.
	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.
	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.
1	.....	12·2	16·5	0·95	0·95	0·2
2	.....	18·3	15·5	5·6	0·95	0·95
3	.....	20·6	14·5	4·8	0·95	0·95
4	.....	20·6	13·5	4·0	0·95	0·2
5	.....	23·0	12·5	5·6	0·95	0·2
6	.....	33·0	11·5	5·6	0·95	0·2
7	.....	33·0	10·5	7·2	4·00	0·2
8	.....	61·0	9·4	5·6	20·0	0·2
9	.....	74·0	8·3	5·6	16·0	0·2
10	.....	74·0	7·2	4·0	4·0	0·2
11	.....	56·0	6·1	4·0	4·0	0·2
12	.....	50·0	5·0	2·9	1·7	0·2
13	.....	50 0	4·0	2·9	0·95	0·2
14	.....	50·0	3·7	2·9	0·95	0·2
15	.....	200·0	3·5	1·7	0·95	0·2
16	.....	100·0	3·2	1·7	0·95	
17	.....	71·0	3·0	1·7	0·95	
18	.....	64·0	2·7	0·95	1·7	
19	.....	57·0	2·4	0·2	0·95	
20	.....	64·0	2·1	0·2	0·2	
21	.....	64·0	1·8	1·7	0·2	
22	.....	64·0	1·6	1·7	0·2	
23	.....	57·0	1·3	2·9	1·2	
24	3·0	57·0	1·0	4·0	0·2	
25	4·8	51·0	0·8	4·0	0·2	
26	6·0	19·7	0·5	2·9	0·2	
27	6·0	19·7	0·93	2·9	0·2	
28	6·5	19·7	0·95	2·9	0·2	
29	10·5	19·7	0·95	1·7	0·2	
30	10·5	18·5	0·95	1·7	0·95	
31	.....	17·5	.....	0·95	0·2	

MONTHLY DISCHARGE of Cherry Creek, at Cornwall's Ranch, for 1912.
(Drainage area, 33 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	10·5	0·0	1·57	0·05	0·06	95·2	
May	200·0	12·2	49·6	1·5	1·72	3,050·0	
June	16·5	0·5	5·5	0·17	0·19	327·3	
July	7·2	0·2	3·1	0·1	0·11	190·6	
August	20·0	0·2	2·1	0·06	0·07	129·1	
September	0·9	0·2	0·2	0·006	0·01	11·9	
The period	.....	.....	.....	.....	2·1	.....	12

NOTE.—Drainage area of Cherry creek is 70 square miles; but above the gauge only 33 square miles. The maximum discharge on May 15, 1912, was due to the failure of a storage dam at the head of the creek. The effect of this large flow was to wash out the gauge, and so alter the channel that a new discharge curve had to be made. The normal maximum discharge for the month of May was 74 second feet. To obtain the total discharge of Cherry creek drainage, add the flow of Alkali creek, Dairy creek and Pendleton creek.

Accuracy, "B."

CHILLIWACK RIVER.

Chilliwack river has its source in Chilliwack lake, at an elevation of 2,080 feet. It passes through Vedder River channel and empties into Sumas lake, which is only about 100 feet above sea-level. The drainage area is about 450 square miles, about

one-quarter of the watershed lying in the state of Washington. The district is very humid, the precipitation being from 40 inches to 70 inches per annum. The water is at present unused, but there are power possibilities on the stream; it may also be used for logging.

The control of the flow of this river is of great importance in connection with the Sumas Dyking Project. Chilliwack river is subject to severe floods and, owing to its flat grade on the lower reaches, is a source of considerable damage to the rich farming districts in that locality. For the upper two-thirds of its length the river is separated from the valley of the Fraser by the Cheam mountains, the highest peak of which rises to an elevation of 9,000 feet. Opposite, on the south, Mount Baker rises abruptly to an even greater height. The bottom slopes of the valley are well covered with timber, some of it excellent quality. A wagon road has been constructed from the lower end of the valley, near Chilliwack, some eight miles up the river; beyond this there are evidences of an old trail, very much overgrown, and impassable in many places. The slopes of the valley in its lower reaches are characterized by high bluffs of sedimentary or glacial origin, subject to enormous slides or slips. The stream has a fast current, and its bed is composed of large boulders that have been washed out of the many slides along its course. The elevation of Chilliwack lake is 2,080 feet, the shores and adjacent slopes being covered with alder and brush. The lake has an area of about 2,600 acres.

The lower reaches of this river seem to have been changed, very much due to dykes and other artificial conditions; previously it seems to have spread over the country in a number of channels, most of which finally found their way to the Fraser.

Chilliwack river used to flow through what is now called Luckaluck channel to the Fraser. Some twenty years ago the river was dammed and diverted by the residents living along that channel (near Sardis), and made to flow through the channel of Vedder creek into Sumas lake. And indeed the Chilliwack is locally referred to as Vedder river.

There are doubtless excellent power possibilities on Chilliwack river, but on account of inaccessibility and the probable high cost of development they have not been carefully investigated.

The station was established on November 14, 1911, by K. H. Smith, and is located about 6 miles from the town of Chilliwack, about 300 yards above the highway bridge known as Vedder river crossing. The gauge is a standard vertical staff gauge, 8 feet long, and is attached to a rock-filled crib.

Measurements are made by current meter from a canoe suspended from a cable attached to the cribbing, to which the gauge is secured, or by using a special traveller on the cable, from which the meter is suspended.

The banks are moderately high and are protected by timber cribbing, and the stream is confined to a single channel. There are two bench-marks which are referred to the datum of the gauge.

Discharge Measurements of Chilliwack River, Three Miles above Mouth, for 1911-12.

Date	Hydrographer.	Meter No.	Width	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
1911.							
Dec. 18	K. H. Smith	1057	76	450	2·6	1·7	1180
1912.							
Mar. 21	C. G. Cline	1046	65	420	1·8	1·0	750
Mar. 22	"	1046	65	508	1·5	1·0	774
July 8	"	1046	82	660	4·7	2·9	3 090
Aug. 30	"	1046	65	550	2·0	1·6	1 120
Nov. 21	"	1048	85	680	5·3	3·15	3·640

DAILY GAUGE HEIGHT AND DISCHARGE of Chilliwack River, Three Miles Above Mouth, for 1911.

(Drainage area, 450 square miles.)

Day.	NOVEMBER.		DECEMBER.	
	Guage height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			2·2	1750
2			2·2	1750
3			2·1	1620
4			2·1	1620
5			2·15	1685
6			2·15	1685
7			2·0	1500
8			2·5	2250
9			2·5	2250
10			2·3	1900
11			2·2	1750
12			2·1	1620
13			2·0	1500
14			1·9	1390
15			1·9	1390
16	0·9	730	1·8	1290
17	2·5	2,250	1·7	1200
18	6·2	11,050	1·6	1120
19	4·6	7,040	1·8	1290
20	4·2	6,020	1·7	1200
21	3·6	4,570	1·6	1120
22	3·15	3,540	1·95	1445
23	2·7	2,630	2·2	1750
24	2·45	2,160	1·9	1390
25	2·9	3,020	1·8	1290
26	3·4	4,100	1·7	1200
27	2·9	3,020	1·7	1200
28	2·6	2,440	1·6	1120
29	2·3	1,900	1·5	1040
30	2·2	1,750	1·5	1040
31			1·4	970

MONTHLY DISCHARGE of Chilliwack River, Three Miles Above Mouth, for 1911.

(Drainage area, 450 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAIN-FALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
December	2250	970	1,462	3·2	3·7	89,800	
The period							85

NOTE.—Accuracy, "A."

DAILY GAUGE HEIGHT AND DISCHARGE of

Day.	January.		February.		March.		April.		May.		June.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	1·4	970	2·6	2,440	1·5	1,040	1·2	860	1·6	1,120	3·2	3,650
2	1·35	940	2·4	2·070	1·4	970	1·4	970	1·6	1·120	3·2	3,650
3	1·3	910	2·3	1,900	1·4	970	1·4	970	1·6	1,120	3·2	3,650
4	1·3	910	2·2	1,750	1·3	910	1·3	910	1·6	1·120	3·2	3,650
5	1·2	860	2·2	1·750	1·3	910	1·3	910	1·7	1,200	3·6	4,570
6	1·2	860	2·1	1,620	1·3	910	1·3	910	1·7	1,200	4·0	5.530
7	1·15	835	2·2	1,750	1·3	910	1·3	910	2·1	1,620	4·4	6,530
8	1·0	810	2·3	1,900	1·3	910	1·4	970	3·1	3·430	5·1	8,300
9	1·15	835	2·4	2,070	1·2	860	1·4	970	3·6	4,570	4·6	7,040
10	1·1	810	2·9	3·020	1·2	860	1·5	1,040	3·2	3,650	4·4	6,530
11	1·1	810	2·6	2,440	1·2	860	1·6	1·120	3·1	3·430	4·4	6,530
12	1·2	860	2·5	2·250	1·2	860	1·5	1,040	3·5	4,340	5·0	8,050
13	1·4	970	2·4	2·070	1·2	860	1·5	1,040	4·0	5·530	4·6	7,040
14	1·95	1,445	2·4	2,070	1·2	860	1·5	1,040	4·7	7,290	4·4	6,530
15	2·0	1,500	2·4	2,070	1·2	860	1·4	970	5·3	8,800	4·0	5,530
16	2·05	1,560	2·5	2,250	1·2	860	1·4	970	4·3	6·270	3·8	5,040
17	1·9	1,390	2·6	2·440	1·2	860	1·4	970	3·7	4·800	3·6	4,570
18	1·7	1,200	2·5	2,250	1·2	860	1·4	970	3·7	4,800	4·2	6,020
19	1·6	1,120	2·3	1,900	1·1	810	1·4	970	4·4	6,530	4·7	7,290
20	1·9	1,390	2·2	1,750	1·1	810	1·4	970	4·7	7,290	5·4	9,050
21	1·8	1,230	2·1	1,620	1·0	770	1·4	970	4·7	7,290	5·3	8,800
22	1·6	1,120	2·2	1,750	1·0	770	1·4	970	4·2	6,020	4·4	6,530
23	1·6	1,120	2·2	1,750	1·0	770	1·4	970	3·9	5,280	4·3	6,270
24	2·0	1,500	1·9	1,390	1·0	770	1·4	970	3·6	4,570	4·7	7,290
25	3·2	3,650	1·9	1,390	1·1	810	1·4	970	3·8	5,040	5·3	8,800
26	2·6	2,440	1·7	1,200	1·2	860	1·4	970	4·9	7,790	5·3	8,800
27	2·3	1,900	1·7	1,200	1·2	860	1·4	970	4·7	7,290	5·2	8,550
28	2·5	2·250	1·6	1,120	1·2	860	1·4	970	4·3	6,270	4·1	5,770
29	3·1	3,430	1·5	1,040	1·2	860	1·5	1,040	3·7	4·800	4·2	6,020
30	3·5	4,340	.....	.....	1·2	860	1·6	1,120	3·5	4,340	4·2	6,020
31	2·9	3,020	.....	.....	1·2	860	.....	.....	3·4	4,100	.....	.....

SESSIONAL PAPER No. 25f

Chilliwack River, Three Miles above mouth, for 1912.

July.		August.		September.		October.		November.		December.		
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Day
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
3·8	5,040	2·0	1,500	1·6	1,120	1·0	770	1·2	860	2·2	1,750	1
4·0	5·530	2·0	1,500	1·8	1·290	1·0	770	1·2	860	2·2	1,750	2
3·6	4,570	1·9	1,390	2·0	1,500	1·0	770	1·2	860	2·2	1,750	3
3·2	3,650	1·8	1,290	1·8	1,290	1·1	810	1·2	860	2·2	1,750	4
3·4	4,100	1·8	1,290	1·7	1,200	1·1	810	1·2	860	2·0	1,500	5
3·3	3,870	1·7	1,200	1·5	1,040	1·1	770	1·2	860	1·9	1,390	6
3·3	3,870	1·7	1,200	1·5	1,040	1·0	770	1·3	910	1·8	1,290	7
3·0	3,230	1·7	1,200	1·5	1,040	1·0	770	1·3	910	1·7	1,200	8
3·1	3,430	2·1	1,620	1·5	1,040	1·0	770	1·3	910	1·7	1,200	9
3·1	3,430	2·0	1,500	1·4	970	1·0	770	1·4	970	1·7	1,200	10
3·0	3,230	2·4	2,070	1·4	970	1·0	770	1·45	1,005	1·7	1,200	11
2·9	3,020	2·0	1,500	1·3	910	1·0	770	1·6	1,120	1·75	1,245	12
3·3	3,870	1·9	1,390	1·3	910	1·0	770	4·1	5·770	1·75	1,245	13
3·2	3,650	1·7	1,200	1·3	910	1·0	770	3·2	3·650	1·65	1,160	14
3·0	3,230	1·7	1,200	1·3	910	0·9	730	2·8	2,820	1·65	1,160	15
3·0	3,230	1·9	1,390	1·2	860	1·0	770	2·2	1,750	1·6	1,120	16
2·9	3,020	2·2	1,750	1·2	860	1·6	1,120	2·3	1,900	1·6	1,120	17
2·9	3,020	2·2	1,750	1·2	860	1·4	970	3·2	3,650	1·6	1·120	18
2·9	3,020	2·1	1,620	1·2	860	1·4	970	4·6	7·040	1·6	1,120	19
2·9	3,020	2·0	1,500	1·2	860	1·3	910	3·6	4,570	1·55	1,080	20
2·8	2,820	2·0	1,500	1·2	860	1·4	970	3·2	3,650	1·55	1,080	21
2·8	2,820	1·9	1,390	1·2	860	1·4	970	3·2	3,650	1·55	1,080	22
2·5	2·250	1·9	1,390	1·2	860	1·3	910	3·3	3,870	1·5	1,040	23
2·4	2.070	1·8	1,290	1·2	860	1·3	910	3·1	3,430	1·5	1,040	24
2·4	2,070	1·8	1,290	1·2	860	1·8	1,290	2·8	2,820	1·5	1,040	25
2·4	2,070	1·8	1,290	1·1	810	1·8	1,290	2·6	2·440	1·5	1,040	26
2·3	1,900	1·7	1,200	1·1	810	1·6	1,120	2·6	2,440	1·5	1,040	27
2·2	1,750	1·7	1,200	1·0	770	1·5	1,040	2·5	2,250	1·5	1,040	28
2·2	1,750	1·6	1,120	1·0	770	1·4	970	2·3	1,900	1·6	1,120	29
2·1	1,620	1·6	1,120	1·0	770	1·4	970	2·25	1,825	1·6	1,120	30
2·1	1,620	1·6	1,120	....	.....	1·3	910	.....	.....	1·7	1,200	31

MONTHLY DISCHARGE of Chilliwack River, Three Miles Above Mouth, for 1912.

(Drainage area, 450 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
January	4,340	810	1,518	3·4	3·9	93,400	
February	3,020	1,040	1,870	4·2	4·5	107,600	
March	1,040	770	865	1·9	2·2	53,200	
April	1,120	860	980	2·2	2·5	58,300	
May	8,800	1,120	4,581	10·2	11·8	281,600	
June	9,050	3,650	6,387	14·2	15·8	380,000	
July	5,530	1,620	3,089	6·9	7·9	190,000	
August	2,070	1,120	1,386	3·1	3·6	852,000	
September	1,500	770	956	2·1	2·3	56,900	
October	1,290	770	893	2·0	2·3	54,900	
November	7,040	860	2,347	5·2	5·8	139,000	
December	1,750	1,040	1,232	2·7	3·1	75,700	
The year	9,050	770	2,175	4·8	65·7	2,342,600	85

NOTE.—Accuracy "A" up to 4,000 c.f.s. Accuracy "B" above 4,000 c.f.s.

COLUMBIA RIVER.

Columbia river rises in East Kootenay, British Columbia, in north latitude 50° 15′, and west longitude 115° 50′ at an elevation of 2,700 feet above mean sea-level. The river actually commences in Upper Columbia lake within 1½ miles of Kootenay river, from which it is separated only by Canal flat. This lake is about 8 miles long in a north and south direction, and from 1 to 2 miles wide. Thence the river flows almost due north for six miles and widens into lake Windermere, which is about the same size as the Upper lake. From lake Windermere the river flows in a northwest direction for 160 miles to the 'Big Bend,' in latitude 52° 02′, longitude 118° 25′. It then turns abruptly southward and flows for 125 miles to the Arrow lakes. Soon it crosses the International boundary into the state of Washington, and empties into the Pacific.

Of the total length of 1,150 miles, some 465 are in British Columbia. The drainage area above the International boundary, and including Pend d'Oreille and Kootenay rivers, is about 60,000 square miles. The total drainage area is about 259,000 square miles.

Columbia river, in its course through British Columbia, may be conveniently divided for hydrographic purposes into five sections. First, from its source in Upper Columbia lake to the town of Golden, on the main line of the Canadian Pacific railway, a distance of some 90 miles. Second, from Golden to the "Big Bend," a distance of about 90 miles. Third, from the "Big Bend" to Upper Arrow lake, about 25 miles south of Revelstoke, on the C.P.R. Fourth, through the Arrow lakes to where the river is joined by its largest tributary, Kootenay river. And fifth, from the mouth of Kootenay river to the mouth of Pend d'Oreille river, near where the Columbia enters the state of Washington.

Extracts from Water Supply Paper No. 252, "The North Pacific Coast" (U.S. Geological Survey):—

"The total drainage area of the Columbia is estimated from the best available maps to be 259,000 square miles, divided as follows:—

Oregon	55,370	square	miles.
Washington	48,000	"	"
Idaho	81,380	"	"
Montana	25,000	"	"
Nevada	5,280	"	"
Wyoming	5,270	"	"
British Columbia	38,700	"	"

(Not including Pend d'Oreille river.)

"The area drained by the Columbia includes perhaps the largest consolidated area of forests in the world. Originally almost the entire area, except those arid portions midway between the mountain ranges, was covered with dense forests, and although the territory has been settled for about sixty-five years and large areas have been cleared, the percentage of forested area to the entire area has been reduced but slightly. It is believed that at least 45 per cent of the drainage area of Columbia river is forested.

"The rainfall is distributed over the area most irregularly. From the Pacific coast eastward to the summit of the Coast range the mean annual rainfall varies from 100 to 150 inches. In the basins between the Coast and Cascade ranges, it drops to about 40 inches per annum. It increases again to about 100 inches on the summit of the Cascade range, and decreases very rapidly to beyond the summit, until at the eastern base of the Cascades it has dropped to about 14 inches. At the mouth of Snake river the mean annual rainfall is about 9 inches, but this extremely low rainfall obtains only in the lower altitudes.

"The climate of the area exhibits all the variations from the rigorous climate of the northern latitudes, as found in British Columbia and the higher table-lands of Oregon and Idaho, to the mild climate of Western Oregon and Washington.

"As regards irrigation, the area ranges from the extremely arid region, where irrigation is absolutely essential, through the semi-arid country, where dry farming and irrigation are practised side by side, to the humid country that, strictly speaking, is arid in the summer months."

Columbia River (above golden.)

Columbia river above Golden elevation 2,800 feet flows through an alluvial valley from one to two miles wide, lying between the Stanford, Brisco and Beaverfoot ranges of the Rockies on the east, and the Selkirk range on the west, its general direction being northwest. The river is navigable from Golden to lake Windermere for flat-bottom steamers, and meanders through the valley in tortuous channels and side channels, now close to the benches on the one side, then hugging the opposite shore. The direct distance from lake Windermere to Golden is increased by a dozen miles via the winding main channel of the river. The river is from 200 to 400 feet wide; it has a depth at low water of from 2 to 6 feet; the difference between low and high water level is from 6 to 12 feet. The velocity of the current varies from 2 feet per second (surface velocity) at low water, to 6.5 feet per second at high water. The river has an average gradient of one foot per mile.

During June, July and August, when the summer's sun melts the ice and snow on the glaciers and mountains, most of the tributaries of the Columbia become raging torrents, and the river itself soon floods nearly all the bottom lands of the valley

to a depth ranging from 1 to 4 feet. At this time, viewing the valley from the vantage of a neighbouring mountain peak, it seems to be one vast lake in which the main channel of the river is distinguishable only by a fringe of cottonwood trees and willow lining the natural levees of its sandy banks. The numerous side-channels, sloughs and meadows are filled with water until about the end of August, when the river begins to lower rapidly, the water in the sloughs following suit more slowly, the recession in them taking place partly through small channels and partly by seepage. In the low places which are on the same level as the low-water mark of the river, water remains all the year round, these ponds being lined with rushes and wild grasses, where duck and geese abound. In the fall the farmers cut wild hay from the dry parts of the sloughs and meadows. A movement is now on foot to reclaim these overflow lands of the Columbia valley (some 50,000 acres in all) by straightening, dredging and dyking the river, and completely controlling the flood waters of the river and its tributaries. It was partly in connection with this possible reclamation that hydrographic studies were made during the summer of 1912 of the upper Columbia and its larger tributaries.

The lower bench lands of the upper Columbia valley are good agricultural lands, especially when irrigated, for which there is a good supply of water in the small streams coming from the high mountains. Several large tracts of land in the Windermere district are now being developed by irrigation companies.

Between Golden and lake Windermere a wagon road runs along the east side of the valley, and it is on this side that nearly all the settlement and farming have taken place. The Kootenay Central branch of the C.P.R., now under construction, will also follow the east side.

The Columbia River Lumber Co., which has large mills at Golden, uses the river extensively for log-driving. This company also operates several flat-bottom steamers on the river, carrying freight and passengers. During the latter part of the season, however, navigation is difficult owing to sandbars and general shallowness.

Most of the tributaries from the east are very small, due to the small drainage of the mountain ranges on that side. On the west, the streams rise in the lofty snowy Selkirks. Dutch creek, Toby creek, Horsethief creek, No. 2 creek, Bugaboo river and Spillimacheen river are all good-sized streams, the latter having an average flood discharge of from 5,000 to 7,000 cubic feet per second.

The Columbia freezes about the middle of November each year and does not break until early in April. The winters are severe, the thermometer sometimes registering—50° F. The snow fall in the valley is about 4 feet. The mean annual precipitation is from 8 inches (near lake Windermere) to 21 inches (near Golden).

On the Selkirk side of the drainage area the precipitation is much greater, being probably 40 inches to 80 inches mostly snowfall. The summers are hot (maximum 90° F.) but the nights are cool (40° F.).

Hydrographic studies were carried on during 1912 at the following stations on the upper Columbia and its tributaries: Columbia river (at Athalmere), Columbia river (at Spillimacheen), Columbia river (at Golden), Toby creek, Horsethief creek, No. 2 creek, Bugaboo river, and Spillimacheen river, besides miscellaneous measurements made at many of the smaller tributaries.

For the detailed hydrographic data of stream flow, see the individual stations and streams.

COLUMBIA RIVER, AT GOLDEN (402).

The station was established October 17, 1911, by C. E. Richardson. The measuring section is located 200 yeards below the Columbia River Lumber Co. mill and half mile above the mouth of Kicking Horse river. A boom runs across 100 yards above the section, and there is a riffle below the section. At high water this section was abandoned and one chosen just below the gauge. Measurements were made by means of an eighth-inch cable stretched across the river, and the measuring done from a boat every ten feet. The channel above the measuring section at low water is straight for over 1,000 feet. The water is uniform in current, being moderately swift near the bank, and slower near the right bank. The channel below the measuring section at low water is straight for over 500 feet. The right bank is low, and lined with some trees. At low water the river uncovers a sandbar along the right bank. At very high water in June and July the right bank overflows. The left bank is steep and lined with timber. It is not liable to overflow. The bed of the stream near the centre and the left bank is gravelly, but near the gauge it is muddy with soggy sawdust. The current is slow near the right bank, and there is not much probability of shifting channel except at very high water. Some silt is borne down by the flood waters of the summer floods, but this should not alter the channel perceptibly. Only one channel, about 400 feet wide at high water, and only 200 feet at low water. The depth in the deepest place at low water is 6 feet, and the river rises from 10 to 12 feet at the flood.

The measurements at this station should be good. There is no probability of back water from Kicking Horse river, or altered conditions at different seasons. The river freezes in November, and does not break up till April 1. Gauge readings during the frozen period will not be of much use, as the gauge is in a very shallow place, where the ice and mud prevent the gauge from registering any fluctuations in the flow under ice cover.

The gauge is a vertical staff, 2 inches by 4 inches by 12 feet (cedar), marked in feet and inches, replacing a similar gauge set by the lumber company many years ago. Zero is at the top, and represents the high-water mark of 1894. The gauge reads down to 12 feet. It is fastened to an 18-inch pile opposite the mill, near the right bank. Within a few feet of the lumber company gauge, a new gauge has recently (summer of 1912) been set. This gauge is divided in feet and tenths, with the zero at the bottom as in hydrographic survey gauges. It might be advisable to transfer to the new gauge, for convenience. All readings from 1903 to October, 1912, are on old gauge, *i. e.*, in feet and inches, and readings from the top. Instead of depending on the lumber company's storekeeper (who reads their gauge until October each year) we secured a new gauge reader to read the second gauge (here described) three times per week until freeze-up.

The following bench-marks were established, and referred to the zero of the gauge No. 1:—

B.M. No. 1.—Bench-mark in head of 3-inch nail on pile on lower side of log-way near the right bank of river. Elevation, 7'·25.

B.M. No. 2.—Bench-mark is head of 3-inch nail in base rail of north-west corner of mill building. Elevation 1' ·20.

B.M. No. 3.—Head of 5-inch spike in base of trestle on horizontal beam of log-way of mill, on lower side. Elevation, 1'·15.

Gauge No. 1 is the lumber company gauge, reading (with zero at high-water mark of 1894) downward.

Gauge No. 2 is new gauge within a few feet of gauge No. 1, with the zero at the bottom and reading up.

To connect the two gauges the following simultaneous readings were taken:—

July 28, 1912.—Gauge No. 1.=5′ 7·9″. Gauge No. 2=7′ ·00″.

October 1, 1912.—Gauge No. 1.=10′ ·6″. Gauge No. 2=2′ ·12″.

Or, the zero of gauge No. 2 is 0·64 feet below the 12-foot mark on gauge No. 1, or is 12·64 feet below the zero of gauge No. 1.

Note that all elevations of bench-marks are negative, *i.e.*, are below the zero of the gauge, which is at the top of the gauge.

SESSIONAL PAPER No. 25f

DISCHARGE MEASUREMENTS of Columbia River, at Golden (402), for 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
1911.							
Oct. 17	C. E. Richardson	1048	176	792	2·3	10·75	1,870
1912.							
Feb. 20	"	1048	175	615	1·3		795*
June 4	H. C. Hughes	1055	200	1,026	3·0	9·17	3,100
June 8	"	1055	218	1,275	3·5	8·05	4·490
June 24	"	1055	430	2,485	4·3	5·05	9·700
July 4	"	1055	385	1,915	4·6	5·36	8,800
July 28	"	1055	375	2,000	4·1	5·64	8·300
Oct. 1	C. E. Richardson	1055	180	798	2·5	10·50	2,020

NOTE.—The discharge curve was projected up to gauge height 0·0 by means of area and velocity curves, and the flood discharge of the year 1894 estimated very closely.

*Ice-cover.

DAILY GAUGE HEIGHT AND DISCHARGE

Day	APRIL.		MAY.		JUNE.		JULY.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	.....	10·5	2,050	6·8	6,300	12·8	15,300
2	.....	.....	10·5	2,050	5·9	7,900	3·2	14,200
3	.....	.....	10·3	2,150	5·2	9,300	3·5	13,300
4	.....	.....	10·5	2,050	4·7	10,400	3·7	12,800
5	.....	.....	10·4	2,100	4·4	11,000	3·8	12,500
6	.....	.....	10·2	2,200	4·3	11,300	4·1	11,800
7	.....	.....	10·0	2,350	4·1	11,800	4·3	11,300
8	.....	.....	9·9	2,450	3·9	12,300	4·4	11,000
9	.....	.....	9·7	2,600	3·7	12,800	4·6	10,600
10	.....	.....	9·8	2,500	3·5	13,300	4·6	10,600
11	.....	.....	9·8	2,500	3·3	13,900	4·7	10,400
12	.....	.....	9·8	2,500	3·0	14,800	4·7	10,400
13	.....	.....	9·8	2,500	2·7	15,600	4·7	10,400
14	.....	.....	9·5	2,800	2·2	17,100	4·8	10,200
15	.....	.....	8·8	3,500	1·9	18,100	4·8	10,200
16	11·2	1,650	8·4	4,000	1·6	19,100	4·8	10,200
17	11·1	1,700	8·4	4,000	1·3	20,100	4·8	10,200
18	11·0	1,750	8·4	4,000	1·2	20,500	4·8	10,200
19	11·0	1·750	8·6	3·750	1·1	20·800	4·8	10,200
20	10·9	1,800	8·8	3,500	1·1	20,800	4·9	9,900
21	10·8	1,850	8·8	3,500	1·2	20,500	5·0	9,700
22	10·8	1,850	8·9	3,400	1·5	19,400	5·1	9,500
23	10·7	1,900	9·1	3,150	1·7	18,800	5·1	9,500
24	10·7	1,900	9·1	3,150	2·0	17,800	5·0	9,700
25	10·6	1,950	9·1	3,150	2·2	17,100	5·0	9,700
26	10·5	2,050	8·9	3,400	2·4	16,500	4·9	9,900
27	10·3	2,150	8·6	3,750	2·6	15,900	4·6	10,600
28	10·2	2,200	8·2	4,250	2·6	15,900	4·6	10,600
29	10·2	2,200	7·8	4,800	2·7	15,600	4·6	10,600
30	10·3	2,150	7·7	4,900	2·8	15,300	4·6	10,600
31	.....	.....	7·4	5,400	.....	.....	4·6	10,600

of Columbia River, at Golden, for 1903.

Day.	August.		September.		October.		November.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	4·6	10,600	6·1	7,500	6·6	6·700	9·4	2,900
2	4·6	10,600	6·3	7,200	6·7	6,500	9·4	2,900
3	4·6	10,600	6·6	6,700	6·9	6,100	9·5	2,800
4	4·6	10,600	6·7	6,500	7·3	5,500	9·5	2,800
5	4·6	10,600	6·8	6,300	7·7	4,800	9·5	2,800
6	4·7	10,400	7·0	6,000	8·0	4,500	9·6	2,700
7	4·9	9,900	7·1	5,800	8·2	4,250	9·6	2,700
8	4·9	9,900	7·4	5,400	8·3	4,100	9·6	2,700
9	4·9	9,900	7·7	4,900	8·6	3,750	9·6	2,700
10	5·0	9,700	7·9	4,650	8·7	3,650	9·6	2,700
11	5·0	9,700	8·0	4,500	8·7	3,650	9·6	2,700
12	5·0	9,700	8·3	4,100	8·7	3,650	9·6	2,700
13	5·0	9,700	8·5	3,900	8·8	3,500	9·6	2,700
14	5·1	9,500	8·6	3,750	8·8	3,500	9·6	2,700
15	5·1	9,500	8·6	3,750	8·9	3,400	9·7	2,600
16	5·1	9,500	8·7	3,650	8·9	3,400	9·7	2,600
17	5·2	9,300	8·8	3,500	8·9	3,400	9·7	2,600
18	5·2	9,300	8·8	3,000	9·0	3,300	9·7	2,600
19	5·2	9,300	9·0	3,300	9·2	3,050	9·7	2,600
20	5·2	9,300	·1	3,150	9·2	3,050	9·7	2,600
21	5·3	9,100	9·2	3,050	9·2	3,050	9·7	2,600
22	5·3	9,100	9·4	2,900	9·2	3,050	9·8	2,500
23	5·3	9,100	9·4	2,900	9·2	3,050	9·8	2,500
24	5·3	9,100	9·3	3,000	9·1	3,150	.....	.....
25	5·4	8,900	7·5	5,200	9·1	3,150	.....	.....
26	5·4	8,900	7·0	6,000	9·0	3,300	.....	.....
27	5·5	8,700	6·7	6,500	9·1	3,150	.....	.....
28	5·7	8,300	6·5	6,800	9·2	3,050	.....	.....
29	5·8	8,100	6·5	6,800	9·2	3,050	.....	.....
30	5·8	8,100	6·5	6,800	9·3	3,000	.....	.....
31	5·9	7,900	.....	.....	9·3	3,000	.....	.....

Monthly Discharge of Columbia River at Golden, for 1903.

(Drainage area, 2,500 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
April	2,200	1,650	1,800	0·72	0·8	107,000
May	5,400	2,050	3,174	1·27	1·5	195,000
June	20,800	6,300	15,330	6·13	6·8	910,000
July	15,300	9,500	10,860	4·34	5·0	664,000
August	10,600	7,900	9,448	3·78	4·4	581,000
September	7,500	2,900	4,933	1·97	2·2	293,000
October	6,700	3,000	3,800	1·52	1·7	233,000
November	2,900	2,500	2,600	1·04	1·2	155,000

Note.—The year 1903 was one of large flood, although by no means as great as 1894. Maximum discharge, 1894, was 24,600 c.f.s.

Gauge read only during the open season. Accuracy, "A" up to 12,000 c.f.s. Accuracy "B" over 12,000 c.f.s. The winter flow varies from 800 to 1,200, reaching its minimum about the end of February.

Daily Gauge Height and Discharge

Day.	April.		May.		June.		July.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	.....	8·0	4,500	7·3	5,500	4·4	11,000
2	.....	.....	8·0	4,500	7·2	5,700	4·2	11,600
3	.....	.....	8·1	4,400	7·0	6,000	4·0	12,000
4	.....	.....	8·2	4,250	6·7	6,500	3·7	12,800
5	.....	.....	8·3	4,100	6·2	7,300	3·5	13,300
6	.....	.....	8·3	4,100	6·1	7,500	3·2	14,200
7	.....	.....	8·5	3,900	5·7	8,300	2·8	15,300
8	.....	.....	8·7	3,650	5·6	8,500	2·4	16,500
9	.....	.....	9·0	3,300	5·5	8,700	2·2	17,100
10	.....	.....	9·0	3,300	5·4	8,900	2·0	17,800
11	.....	.....	9·1	3,150	5·4	8,900	1·9	18,100
12	.....	.....	9·2	3,050	5·5	8,700	2·0	17,800
13	10·6	1,950	9·3	3·000	5·6	8,500	2·0	17,800
14	10·2	2,200	9·2	3,050	5·8	8,100	2·1	17,500
15	9·8	2,500	9·2	3,050	5·8	8,100	2·4	16,500
16	9·6	2,700	9·1	3,150	5·8	8,100	2·7	15,600
17	9·7	2,600	9·0	3,300	5·3	9,100	3·0	14,800
18	9·8	2,500	8·7	3,650	5·1	9,500	3·4	13,600
19	9·7	2,600	8·7	3,650	4·7	10,400	3·7	12,800
20	9·6	2,700	8·0	4,500	4·5	10,800	3·9	12,300
21	9·4	2,900	7·5	5,200	4·4	11,000	4·2	11,600
22	9·1	3·150	7·1	5,800	4·4	11,000	4·5	10,800
23	9·1	3,150	6·7	6,500	4·2	11,600	4·7	10,400
24	8·7	3,650	6·6	6,700	4·3	11,300	4·8	10,200
25	8·7	3,650	6·4	7,000	4·4	11,000	5·0	9,700
26	8·8	3,500	6·5	6,800	4·5	10,800	5·1	9,500
27	8·7	3,650	6·8	6,300	4·6	10,600	5·1	9,500
28	8·5	3,900	7·0	6,000	4·7	10,400	5·1	9,500
29	8·2	4,250	7·2	5,700	4·7	10,400	5·1	9,500
30	8·0	4,500	7·4	5,400	4·7	10,400	5·1	9,500
31	.....	.....	7·4	5,400	.....	.....	5·1	9,500

of Columbia River, at Golden, for 1904.

August.		September.		October.		November.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
5·1	9,500	7·4	5,400	9·5	2,800	11·2	1,650	1
5·2	9,300	7·3	5,500	9·5	2,800	11·2	1,650	2
5·2	9,300	7·3	5,500	9·5	2,800	11·2	1,650	3
5·3	9,100	7·2	5,700	9·3	3,000	11·2	1,650	4
5·4	8,900	7·1	5,800	9·4	2,900	11·2	1,650	5
5·4	8,900	7·1	5,800	9·7	2,600	11·2	1,650	6
5·4	8,900	7·1	5,800	10·0	2,350	11·2	1,650	7
5·4	8,900	7·0	6,000	10·2	2,200	11·2	1,650	8
5·4	8,900	7·1	5,800	10·3	2,150	11·2	1,650	9
5·4	8,900	7·1	5,800	10·4	2,100	11·3	1,625	10
5·4	8,900	7·2	5,700	10·5	2,050	11·3	1,625	11
5·4	8,900	7·3	5,500	10·5	2,050	11·3	1,625	12
5·3	9,100	7·7	4,900	10·5	2,050	11·3	1,625	13
5·4	8,900	7·8	4,800	10·5	2,050	11·3	1,625	14
5·4	8,900	8·0	4,500	10·6	1,950	11·3	1,625	15
5·4	8,900	8·2	4,250	10·6	1,950	11·3	1,625	16
5·5	8,700	8·3	4,100	10·6	1,950	11·2	1,650	17
5·5	8,700	8·6	3,750	10·7	1,900	11·2	1,650	18
5·5	8,700	8·9	3,400	10·7	1,900	11·2	1,650	19
5·5	8,700	9·2	3,050	10·7	1,900	11·2	1,650	20
5·7	8,300	9·3	3,000	10·8	1,850	11·2	1,650	21
6·0	7,700	9·5	2,800	10·9	1,800	11·2	1,650	22
6·3	7,200	9·8	2,500	10·9	1,800	11·3	1,625	23
6·8	6,300	9·8	2,500	11·0	1,750	11·3	1,625	24
7·0	6,000	9·7	2,600	11·0	1,750	...		25
7·2	5,700	9·8	2,500	11·1	1,700			26
7·5	5,200	9·9	2,450	11·1	1,700			27
7·5	5,200	9·6	2,700	11·2	1,650	...	...	28
7·4	5,400	9·5	2,800	11·2	1,650			29
7·4	5,400	9·5	2,800	11·2	1,650			30
7·4	5,400	...	...	11·2	1,650	...		31

Monthly Discharge of Columbia River at Golden, for 1904.

(Drainage area, 2,500 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
April	4,500	1,950	3,000	1·20	1·34	178,500
May	7,000	3,000	4,527	1·81	2·1	278,500
June	11,600	5,500	9,053	3·62	4·0	538,500
July	18,100	9,500	13,164	5·27	6·1	805,500
August	9,500	5,200	7,961	3·18	3·7	489,400
September	6,000	2,500	4,256	1·7	1·9	253,500
October	3,000	1,650	2,077	0·83	1·0	127,300
November	1,650	1,625	1,625	0·65	0·7	96,400

Note.—Accuracy "A" up to 12,000 c.f.s.; "B" over 12,000 c.f.s.

DAILY GAUGE HEIGHT AND DISCHARGE

DAY.	MARCH.		APRIL.		MAY.		JUNE.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	.....	11·8	1,400	10·3	2,150	7·5	5,200
2	.....	.....	11·8	1,400	10·4	2,100	6·9	6,100
3	.....	.....	11·7	1,450	10·5	2,050	6·4	7,000
4	.....	.....	11·7	1,450	10·5	2,050	5·9	7,900
5	.....	.....	11·7	1,450	10·7	1,900	5·7	8,300
6	.....	.....	11·7	1,450	10·7	1,900	5·5	8,700
7	.....	.....	11·7	1,450	10·5	2,050	5·2	9,300
8	.....	.....	11·7	1,450	10·4	2,100	5·0	9,700
9	.....	.....	11·7	1,450	9·8	2,500	4·8	10,200
10	.....	.....	11·6	1,500	9·5	2,800	4·7	10,400
11	.....	.....	11·7	1,450	9·2	3,050	4·6	10,600
12	.....	.....	11·7	1,450	9·0	3,300	4·5	10,800
13	.....	.....	11·7	1,450	9·2	3,050	4·5	10,800
14	.....	.....	11·7	1,450	9·3	3,000	4·5	10,800
15	.....	.....	11·8	1,400	9·4	2,900	4·5	10,800
16	.....	.....	11·8	1,400	9·5	2,800	4·5	10,800
17	.....	.....	11·9	1,350	9·6	2,700	4·5	10,800
18	.....	.....	11·9	1,350	9·3	3,000	4·6	10,600
19	.....	.....	11·9	1,350	8·8	3,500	4·8	10,200
20	.....	.....	11·9	1,350	8·5	3,900	5·0	9,700
21	11·3	1,625	11·8	1,400	8·4	4,000	5·2	9,300
22	11·3	1,625	11·8	1,400	8·2	4,250	5·2	9,300
23	11·4	1,575	11·6	1,500	8·1	4,400	5·5	8,700
24	11·4	1,575	11·0	1,750	8·2	4,250	5·6	8,500
25	11·4	1,575	11·0	1,750	8·2	4,250	5·6	8,500
26	11·5	1,550	10·8	1,850	8·4	4,000	5·7	8,300
27	11·6	1,500	10·0	2,350	8·3	4,100	5·8	8,100
28	11·7	1,450	9·8	2,500	8·3	4,100	5·9	7,900
29	11·7	1,450	9·8	2,500	8·2	4,250	6·1	7,500
30	11·8	1,400	10·0	2,350	8·1	4,400	6·2	7,300
31	11·8	1,400	.....	.....	7·8	4,800	.....	.....

of Columbia River, at Golden, for 1905.

July.		August.		September.		October.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
6·1	7,500	4·6	10,600	7·5	5,200	9·2	3,050	 1
6·1	7,500	4·6	10,600	7·5	5,200	9·3	3,000	 2
6·0	7,700	4·6	10,600	7·6	5,000	9·6	2,700	 3
5·9	7,900	4·6	10,600	7·7	4,900	9·5	2,800	 4
5·7	8,300	4·7	10,400	7·8	4,800	9·4	2,900	 5
5·6	8,500	4·7	10,400	8·1	4,400	9·3	3,000	 6
5·4	8,900	4·7	10,400	8·4	4,000	9·2	3,050	 7
5·2	9,300	4·7	10,400	8·2	4,250	9·3	3,000	 8
5·1	9,500	4·7	10,400	8·1	4,400	9·3	3,000	 9
5·0	9,700	4·7	10,400	8·0	4,500	9·5	2,800	 10
4·9	9,900	4·6	10,600	7·9	4,650	9·5	2,800	 11
4·8	10,200	4·7	10,400	7·9	4,650	10·1	2,300	 12
4·7	10,400	4·7	10,400	7·9	4,650	10·1	2,300	 13
4·6	10,600	4·8	10,200	8·2	4,250	10·1	2,300	 14
4·7	10,400	4·7	10,400	8·3	4,100	10·2	2,200	 15
4·7	10,400	4·8	10,200	8·6	3,750	10·3	2,150	 16
4·8	10,200	4·8	10,200	9·0	3,300	10·4	2,100	 17
4·8	10,200	5·0	9,700	9·2	3,050	10·5	2,050	 18
5·0	9,700	5·3	9,100	9·2	3,050	10·6	1,950	.. 19
5·0	9,700	5·8	8,100	9·2	3,050	.....	.....	 20
5·1	9,500	6·2	7,300	9·2	3,050	.....	.....	 21
5·1	9,500	6·3	7,200	8·9	3,400	.....	.....	 22
5·1	9,500	6·4	7,000	8·7	3,650	.....	.....	 23
5·1	9,500	6·5	6,800	8·5	3,900	.....	.....	 24
5·0	9,700	7·0	6,000	8·3	4,100	.....	.....	 25
4·9	9,900	7·2	5,700	8·3	4,100	.....	.....	 26
4·8	10,200	7·2	5,700	8·2	4,250	.....	.....	 27
4·7	10,400	7·3	5,500	8·4	4,000	.....	.....	 28
4·7	10,400	7·4	5,400	8·7	3,650	.....	.....	 29
4·6	10,600	7·6	5,000	9·2	3,050	.....	.....	 30
4·6	10,600	7·5	5,200	.....	.....	.....	.....	 31

Monthly Discharge of Columbia River, at Golden, for 1906.

(Drainage area, 2,500 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
March	1,625	1,200	1,500	0·6	0·7	92,200
April	2,500	1,350	1,593	0·64	0·7	94,600
May	4,800	1,900	3,212	1·28	1·5	197,400
June	10,800	5,200	9,070	3·63	4·1	539,700
July	10,600	7,500	9,558	3·82	4·4	587,800
August	10,600	5,000	8,738	3·5	4·0	537,400
September	5,200	3,050	4,076	1·63	1·8	242,800
October	3,050	1,950	2,000	0·8	0·9	123,000

Note.—Accuracy "A" up to 12,000 c.f.s.; "B" over 12,000 c.f.s.

DAILY GAUGE HEIGHT AND DISCHARGE

DAY.	APRIL.		MAY.		JUNE.		JULY.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	11·0	1,750	9·3	3,000	8·2	4,250	5·6	8,500
2	11·2	1,650	8·9	3,400	8·3	4,100	5·4	8,900
3	11·2	1,650	8·6	3,750	8·1	4,400	5·3	9,100
4	11·3	1,625	8·5	3,900	7·8	4,800	5·2	9,300
5	11·4	1,575	8·5	3,900	7·3	5,500	5·1	9,500
6	11·4	1,575	8·8	3,500	7·0	6,000	5·0	9,700
7	11·3	1,625	9·1	3,150	6·8	6,300	4·7	10,400
8	11·2	1,650	9·2	3,050	6·7	6,500	4·5	10,800
9	11·1	1,700	9·3	3,000	7·0	6,000	4·3	11,300
10	11·2	1,650	9·3	3,000	7·1	5,800	4·2	11,600
11	11·2	1,650	8·8	3,500	7·2	5,700	4·0	12,000
12	11·3	1,625	8·0	4,500	7·3	5,500	3·7	12,800
13	11·3	1,625	7·2	5,700	7·0	6,000	3·5	13,300
14	11·3	1,625	7·0	6,000	6·7	6,500	3·3	13,900
15	11·3	1,625	6·7	6,500	6·5	6,800	3·3	13,900
16	11·3	1,625	6·7	6,500	6·4	7,000	3·3	13,900
17	11·2	1,650	6·7	6,500	6·5	6,800	3·4	13,600
18	11·0	1,750	6·8	6,300	6·7	6,500	3·5	13,300
19	10·8	1,850	7·2	5,700	6·9	6,100	3·7	12,800
20	10·8	1,850	7·6	5,000	7·2	5,700	3·8	12,500
21	10·8	1,850	7·8	4,800	7·5	5,200	3·8	12,500
22	10·5	2,050	7·9	4,650	7·7	4,900	4·0	12,000
23	10·0	2,350	8·0	4,500	7·7	4,900	4·0	12,000
24	9·4	2,900	8·0	4,500	7·8	4,800	4·1	11,800
25	9·2	3,050	8·1	4,400	7·7	4,900	4·2	11,600
26	9·2	3,050	8·2	4,250	7·2	5,700	4·2	11,600
27	9·5	2,800	8·2	4,250	6·7	6,500	4·2	11,600
28	9·7	2,600	8·1	4,400	6·2	7,300	4·3	11,300
29	9·7	2,600	8·1	4,400	5·8	8,100	4·3	11,300
30	9·7	2,600	8·2	4,250	5·7	8,300	4·3	11,300
31	.....	.....	8·2	4,250	.....	.....	4·4	11,000

of Columbia River, at Golden, for 1906.

August.		September.		October.		November.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
4·5	10,800	7·1	5,800	9·7	2,600	10·6	1,950	1
4·6	10,600	7·0	6,000	9·8	2,500	10·8	1,850	2
4·8	10,200	6·8	6,300	9·5	2,800	10·9	1,800	3
5·0	9,700	6·8	6,300	9·3	3,000	11·0	1,750	4
5·2	9,300	7·1	5,800	9·7	2,600	11·0	1,750	5
5·3	9,100	7·2	5,700	9·8	2,500	11·1	1,700	6
5·6	8,500	7·2	5,700	9·8	2,500	11·1	1,700	7
5·7	8,300	7·0	6,000	9·8	2,500	11·2	1,650	8
5·8	8,100	6·7	6,500	9·6	2,700	11·3	1,625	9
5·8	8,100	6·1	7,500	9·3	3,000	11·3	1,625	10
5·7	8,300	6·0	7,700	9·4	2,900	11·3	1,625	11
5·6	8,500	6·1	7,500	9·3	3,000	10·9	1,800	12
5·5	8,700	6·3	7,200	9·3	3,000	10·7	1,900	13
5·3	9,100	7·0	6,000	9·3	3,000	10·7	1,900	14
5·3	9,100	7·7	4,900	9·6	2,700	10·6	1,950	15
5·3	9,100	8·3	4,100	9·8	2,500	10·7	1,900	16
5·3	9,100	8·9	3,400	9·9	2,450	10·8	1,850	17
5·3	9,100	9·1	3,150	10·1	2,300	....	..	18
5·4	8,900	8·7	3,650	10·2	2,200	....		19
5·6	8,500	8·3	4,100	10·3	2,150	.....		20
5·8	8,100	8·1	4,400	10·4	2,100	.....		21
6·1	7,500	8·0	4,500	10·6	1,950	...		22
6·4	7,000	8·0	4,500	10·7	1,900	....		23
6·8	6,300	8·1	4,400	10·8	1,850			24
7·0	6,000	8·2	4,250	10·8	1,850			25
7·3	5,500	8·3	4,100	10·4	2,100			26
7·5	5,200	8·8	3,500	10·3	2,150			27
7·5	5,200	9·3	3,000	10·2	2,200			28
7·7	4,900	9·5	2,800	10·0	2,350			29
7·5	5,200	9·6	2,700	10·3	2,150			30
7·3	5,500			10·5	2,050			31

Discharge of Columbia River, at Golden, for 1906.

(Discharge area, 2,500 square miles).

Month.	Discharge in Second-Feet.				Run-Off.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
April	3,050	1,575	1,972	0·79	0·9	117,200
May	6,500	3,000	4,468	1·79	2·1	274,800
June	8,300	4,100	5,895	2·36	2·6	350,500
July	13,900	8,500	11,584	4·63	5·3	713,300
August	10,800	4,900	7,983	3·19	3·7	490,700
September	7,700	2,700	5,048	2·0	2·2	300,500
October	3,000	1,850	2,437	0·97	1·1	150,000
November	1,950	1,625	1,700	0·68	0·8	101,100

Note.—Accuracy "A" up to 12,000 c.f.s.; "B" over 12,000 c.f.s.

DAILY GAUGE HEIGHT AND DISCHARGE

DAY.	APRIL.		MAY.		JUNE.		JULY.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	.....	11·3	1,625	6·6	6,700	3·5	13,300
2	.....	.....	11·3	1,625	6·2	7,300	3·1	14,500
3	.....	.....	11·3	1,625	6·0	7,700	3·0	14,800
4	.....	.....	11·2	1,650	5·9	7,900	2·9	15,100
5	.....	.....	11·1	1,700	5·7	8,300	2·9	15,100
6	.....	.....	11·0	1,750	5·7	8,300	2·9	15,100
7	11·5	1,550	10·9	1,800	5·6	8,500	3·0	14,800
8	11·4	1,575	10·7	1,900	5·5	8,700	3·2	14,200
9	11·4	1,575	10·3	2,150	5·4	8,900	3·3	13,900
10	11·3	1,625	9·8	2,500	5·4	8,900	3·5	13,300
11	11·2	1,650	9·3	3,000	5·4	8,900	3·6	13,100
12	11·2	1,650	9·1	3,150	5·4	8,900	3·7	12,800
13	11·3	1,625	9·0	3,300	5·3	9,100	3·7	12,800
14	11·2	1,650	9·1	3,150	5·3	9,100	3·8	12,500
15	11·1	1,700	9·2	3,050	5·4	8,900	3·8	12,500
16	11·1	1,700	8·7	3,650	5·5	8,700	3·8	12,500
17	11·0	1,750	8·0	4,500	5·5	8,700	3·9	12,300
18	11·2	1,650	7·4	5,400	5·6	8,500	4·0	12,000
19	11·2	1,650	7·2	5,700	5·5	8,700	4·1	11,800
20	11·2	1,650	6·9	6·100	5·4	8,900	4·1	11,800
21	11·2	1,650	6·7	6,500	5·3	9,100	4·2	11,600
22	11·2	1,650	6·5	6,800	5·2	9,300	4·2	11,600
23	11·1	1,700	6·5	6,800	5·1	9,500	4·2	11,600
24	11·0	1,750	6·6	6,700	5·0	9,700	4·2	11,600
25	10.9	1,800	6·8	6,300	4·8	10,200	4·2	11,600
26	11.0	1,750	7·2	5,700	4·5	10,800	4·2	11,600
27	11·2	1,750	7·5	5,200	4·3	11,300	4·2	11,600
28	11·3	1,625	7·6	5,000	4·1	11,800	4·2	11,600
29	11·3	1,625	7·6	5,000	4·0	12,000	4·2	11,600
30	11·3	1,625	7·3	5,500	3·7	12,800	4·2	11,600
31	.....	.....	7·0	6,000	.....	.....	4·2	11,600

of Columbia River, at Golden, for 1907.

August.		September.		October.		November.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
4·1	11,800	6·1	7,500	9·5	2,800	10·3	2,150	1
4·1	11,800	6·2	7,300	9·7	2,600	10·5	2,050	2
4·1	11,800	6·3	7,200	9·6	2,700	10·7	1,900	3
4·1	11,800	6·5	6,800	9·4	2,900	10·7	1,900	4
4·0	12,000	6·6	6,700	9·6	2,700	10·8	1,850	5
4·1	11,800	6·7	6,500	9·7	2,600	10·8	1,850	6
4·1	11,800	6·8	6,300	9·8	2,500	10·9	1,800	7
4·2	11,600	7·0	6,000	9·8	2,500	11·0	1,750	8
4·2	11,600	7·0	6,000	9·9	2,450	11·0	1,750	9
4·4	11,000	7·1	5,800	9·9	2,450	11·1	1,700	10
4·7	10,400	7·1	5,800	9·7	2,600	11·1	1,700	11
4·9	9,900	7·1	5,800	9·7	2,600	11·1	1,700	12
5·2	9,300	7·2	5,700	9·7	2,600	11·1	1,700	13
5·4	8,900	7·2	5,700	9·5	2,800	11·2	1,650	14
5·6	8,500	7·4	5,400	9·5	2,800	11·2	1,650	15
5·8	8,100	7·6	5,000	9·6	2,700	11·3	1,625	16
6·0	7,700	7·8	4,800	9·6	2,700	11·3	1,625	17
6·1	7,500	8·0	4,500	9·4	2,900	11·3	1,625	18
6·2	7,300	8·2	4,250	9·3	3,000	11·3	1,625	19
6·2	7,300	8·3	4,100	9·5	2,800	10·9	1,800	20
6·4	7,000	8·5	3,900	9·7	2,600	10·5	2,050	21
6·6	6,700	8·7	3,650	9·9	2,450	10·7	1,900	22
6·6	6,700	8·7	3,650	10·1	2,300	10·8	1,850	23
6·6	6·700	8·7	3,650	10·3	2,150	10·8	1,850	24
6·5	6·800	8·8	3,500	10·4	2,100	10·9	1,800	25
6·4	7,000	8·9	3,400	10·4	2,100	11·1	1,700	26
6·3	7,200	8·9	3,400	10·5	2,050	.....	.....	27
6·1	7,500	9·1	3,150	10·5	2,050	.....	.....	28
5·9	7,900	9·3	3,000	10·5	2,050	.....	.....	29
5·9	7,900	9·4	2,900	10·3	2,150	.....	.....	30
6·0	7,700	.....	.....	10·2	2,200	.....	.....	31

Monthly Discharge of Columbia River, at Golden, 1907.

(Drainage area, 2,500 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.	
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
April	1,800	1,550	1,600	0·64	0·7	95,200
May	6,800	1,625	4,027	1·61	1·9	247,800
June	12,800	6,700	9,536	3·81	4·2	567,700
July	15,100	11,600	12,767	5·1	5·9	787,000
August	12,000	6,700	9,064	3·63	4·2	557,000
September	7,500	2,900	5,045	2·02	2·3	300,000
October	3,000	2,050	2,513	1·01	1·1	154,300
November	2,150	1,625	1,700	0·68	0·8	101,100

Note.—Accuracy "A" up to 12,000 c.f.s; "B" over 12,000 c.f.s.

DAILY GAUGE HEIGHT AND DISCHARGE

DAY.	APRIL.		MAY.		JUNE.		JULY.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	.....	9·9	2,450	6·5	6,800	4·0	12,000
2	.....	.....	9·7	2,600	6·5	6,800	4·0	12,000
3	.....	.....	9·4	2,900	6·3	7,200	3·9	12,300
4	.....	.....	9·0	3,300	6·1	7,500	3·9	12,300
5	.....	.....	8·7	3,650	5·9	7,900	3·8	12,500
6	11·4	1,575	8·5	3,900	5·5	8,700	3·8	12,500
7	11·4	1,575	8·2	4,250	5·2	9,300	3·7	12,800
8	11·3	1,625	8·0	4,500	4·9	9,900	3·7	12,800
9	11·2	1,650	7·5	5,200	4·7	10,400	3·6	13,100
10	11·2	1,650	7·2	5,700	4·5	10,800	3·5	13·300
11	11·2	1,650	7·1	5,800	4·3	11,300	3·3	13,900
12	11·2	1,650	7·0	6,000	4·1	11,800	3·0	14,800
13	11·1	1,700	7·0	6,000	4·0	12,000	2·8	15,300
14	11·1	1,700	6·7	6,500	3·8	12,500	2·5	16,200
15	11·0	1,750	6·6	6,700	3·6	13,100	2·2	17,100
16	11·0	1,750	6·5	6,800	3·3	13,900	2·0	17,800
17	11·0	1,750	6·3	7,200	3·3	13,900	1·8	18,500
18	10·8	1,850	6·4	7,000	3·3	13,900	1·8	18,500
19	10·7	1,900	6·6	6,700	3·3	13,900	2·0	17,800
20	10·4	2,100	6·7	6,500	3·3	13,900	2·1	17,500
21	10·1	2,300	6·8	6,300	3·5	13,300	2·3	16,800
22	9·7	2,600	7·0	6,000	3·6	13,100	2·3	16,800
23	9·5	2,800	7·1	5,800	3·7	12,800	2·4	16,500
24	9·5	2,800	7·3	5,500	3·7	12,800	2·5	16,200
25	9·5	2,800	7·3	5,500	4·0	12,000	2·5	16,200
26	9·5	2,800	7·1	5,800	4·0	12,000	2·7	15,600
27	9·7	2,600	7·1	5,800	4·0	12,000	2·8	15,300
28	9·8	2,500	6·8	6,300	3·9	12,300	2·9	15,100
29	9·8	2,500	6·7	6,500	4·0	12,000	3·2	14,200
30	9·8	2,500	6·6	6,700	4·1	11,800	3·5	13,300
31	.....	.....	6·5	6,800	.....	.....	3·8	12,500

of Columbia River, at Golden, for 1908.

August.		September.		October.		November.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
3·9	12,300	7·9	4,650	10·1	2,300	10·9	1,800	1
4·2	11,600	8·5	3,900	10·2	2,200	10·9	1,800	2
4·4	11,000	8·6	3,750	10·0	2,350	10·8	1,850	3
4·7	10,400	8·4	4,000	10·1	2,300	10·6	1,950	4
4·9	9,900	8·3	4,100	10·2	2,200	10·5	2,050	5
5·0	9,700	8·3	4,100	10·3	2,150	10·5	2,050	6
5·1	9,500	8·3	4,100	10·3	2,150	10·5	2,050	7
5·2	9,300	8·2	4,250	10·4	2,100	10·6	1,950	8
5·3	9,100	8·2	4,250	10·5	2,050	10·7	1,900	9
5·3	9,100	8·2	4,250	10·5	2,050	10·8	1,850	10
5·3	9,100	8·2	4,250	10·5	2,050	11·0	1,750	11
5·4	8,900	8·3	4,100	10·5	2,050	11·3	1,627	12
5·4	8,900	8·3	4,100	10·6	1,950	11·6	1,500	13
5·3	9,100	8·3	4,100	10·5	2,050			14
5·5	8,700	8·0	4,500	10·4	2,100			15
5·5	8,700	7·7	4,900	10·5	2,050			16
5·7	8,300	7·5	5,200	10·6	1,950			17
5·8	8,100	7·4	5,400	10·6	1,950			18
6·0	7,700	7·5	5,200	10·8	1,850			19
6·3	7,200	7·7	4,900	10·7	1,900			20
6·2	7,300	8·0	4,500	10·7	1,900			21
6·2	7,300	8·2	4,250	10·7	1,900			22
6·2	7,300	8·3	4,100	10·7	1,900			23
6·3	7,200	8·5	3,900	10·8	1,850			24
6·3	7,200	9·2	3,050	10·8	1,850			25
6·3	7,200	9·5	2,800	11·0	1,750			26
6·3	7,200	9·6	2,700	10·8	1,850			27
6·5	6,800	9·8	2,500	11·0	1,750			28
6·6	6,700	10·0	2,350	11·0	1,750			29
7·1	5,800	10·0	2,350	11·0	1,750			30
7·6	5,000			10·9	1,800			31

Monthly Discharge of Columbia River, at Golden, for 1908.

(Drainage area, 2,500 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.	
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
April	2,800	1,575	2,000	0·8	0·9	119,000
May	7,200	2,450	5,505	3·2	2·5	338,500
June	13,900	6,800	11,320	4·53	5·1	672,400
July	18,500	12,000	14,887	5·95	6·9	915,300
August	12,300	5,000	8,438	3·37	3·9	518,800
September	5,400	2,350	4,016	1·6	1·8	239,200
October	2,350	1,750	1,993	0·79	0·9	118,400
November	2,050	1,500	1,600	0·64	0·7	95,200

Note.—Accuracy "A" up to 12,000 c.f.s.; "B" over 12,000 c.f.s.

DAILY GAUGE HEIGHT AND DISCHARGE

DAY.	APRIL.		MAY.		JUNE.		JULY.	
	Guage height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Guage height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			11·7	1,450	6·7	6,500	4·0	12,000
2			11·8	1,400	6·4	7,000	4·1	11,800
3			11·7	1,450	5·6	8,500	4·1	11,800
4			11·5	1,550	5·5	8,700	4·0	12,000
5			11·3	1,625	5·2	9,300	3·8	12,500
6			11·0	1,750	5·0	9,700	3·6	13,100
7			11·1	1,700	4·8	10,200	3·3	13,900
8	11·5	1,550	11·2	1,650	4·7	10,400	3·0	14,800
9	11·5	1,550	11·3	1,625	4·7	10,400	2·5	16,200
10	11·4	1,575	11·3	1,625	4·7	10,400	2·3	16,800
11	11·4	1,575	11·2	1,650	4·7	10,400	2·3	16,800
12	11·4	1,575	11·1	1,700	4·6	10,600	2·3	16,800
13	11·3	1,625	11·0	1,750	4·4	11,000	2·5	16,200
14	11·3	1,625	10·9	1,800	4·3	11,300	2·7	15,600
15	11·3	1,625	10·8	1,850	4·2	11,600	3·1	14,500
16	11·4	1,575	10·6	1,950	4·0	12,000	3·3	13,900
17	11·5	1,550	10·5	2,050	3·7	12,800	3·5	13,300
18	11·5	1,550	10·5	2,050	3·6	13,100	3·7	12,800
19	11·5	1,550	10·6	1,950	3·4	13,600	3·9	12,300
20	11·5	1,550	10·6	1,950	3·3	13,900	4·1	11,800
21	11·5	1,550	10·4	2,100	3·2	14,200	4·2	11,600
22	11·5	1,550	10·3	2,150	3·0	14,800	4·2	11,600
23	11·6	1,500	10·2	2,200	3·0	14,800	4·1	11,800
24	11·6	1,500	10·1	2,300	3·0	14,800	4·5	10,800
25	11·5	1,550	9·8	2,500	3·1	14,500	4·5	10,800
26	11·5	1,550	9·1	3,150	3·3	13,900	4·5	10,800
27	11·5	1,550	8·3	4,100	3·4	13,600	4·5	10,800
28	11·6	1,500	7·8	4,800	3·6	13,100	4·5	10,800
29	11·6	1,500	7·4	5,400	3·9	12,300	4·4	11,000
30	11·7	1,450	7·1	5,800	3·9	12,300	4·4	11,000
31			6·9	6,100			4·6	10,600

of Columbia River, at Golden, for 1909.

August.		September.		October.		November.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Guage height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
4·6	10,600	7·2	5,700	8·7	3,650	10·9	1,800	1
4·6	10,600	7·3	5,500	8·8	3,500	10·9	1,800	2
4·7	10,400	7·4	5,400	9·1	3,150	11·0	1,750	3
4·7	10,400	7·5	5,200	9·7	2,600	11·1	1,700	4
4·8	10,200	7·5	5,200	9·7	2,600	11·2	1,650	5
4·8	10,200	7·6	5,000	9·8	2,500	11·3	1,625	6
4·9	9·900	7·6	5,000	10·0	2,350	11·4	1,575	7
5·1	9,500	7·7	4,900	10·0	2,350	11·5	1,550	8
5·2	9,300	7·7	4,900	10·0	2,350	11·6	1,500	9
5·3	9,100	7·8	4,800	10·1	2,300	11·6	1,500	10
5·3	9,100	7·8	4,800	10·1	2,300	11·7	1,450	11
5·4	8,900	7,9	4,650	10·1	2,300	11·8	1,400	12
5·7	8,300	8·0	4,500	10·2	2,200	11·8	1,400	13
5·9	7,900	8·0	4,500	10·3	2,150	.....	.....	14
6·3	7,200	8·1	4,400	10·3	2,150	.....	.....	15
6·3	7,200	8·2	4,250	10·5	2,050	.....	.....	16
6·3	7,200	8·3	4,100	10·6	1,950	.....	.....	17
6·3	7,200	8·4	4,000	10·6	1,950	.....	.....	18
6·3	7,200	8·7	3,650	10·6	1,950	.....	.....	19
6·4	7,000	9·0	3,300	10·6	1,950	.....	.....	20
6·5	6,800	9·3	3,000	10·7	1,900	.....	.....	21
6·5	6,800	9·7	2,600	10·7	1,900	.....	.....	22
6·6	6,700	9·7	2,600	10·8	1,850	.....	.....	23
6·7	6,500	9·7	2,600	10·8	1,850	.....	.....	24
6·8	6,300	10·0	2,350	10·8	1,850	.....	.....	25
6·9	6,100	10·2	2,200	10·8	1,850	.....	.....	26
6·9	6,100	10·1	2,300	10·8	1,850	.....	.....	27
7·0	6,000	10·2	2,200	10·8	1·850	.....	.....	29
7·0	6,000	10·2	2,200	10·8	1,850	.....	.....	29
7·1	5,800	9·5	2,200	10·9	1,800	.....	.....	30
7·2	5,700	.....	.....	10·9	1,800	.....	.....	31

Monthly Discharge of Columbia River, at Golden, for 1909.

(Drainage area, 2,500 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.	
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
April	1,625	1,450	1,500	0·6	0·7	89,300
May	6,100	1,400	2,423	0·97	1·1	148,800
June	14,800	6,500	11,856	4·7	5·2	705,500
July	16,800	10,600	12,919	5·17	5·9	794,300
August	10,600	5,700	7,942	3·18	3·7	488,200
September	5,700	2,200	3,933	1·57	1·7	233,900
October	3,650	1,800	2,214	0·89	1·0	135,900
November	1,800	1,400	1,400	0·56	0·6	83,300

Note.—Accuracy "A" up to 12,000 c.f.s.; "B." over 12,000 c.f.s.

DAILY GAUGE HEIGHT AND DISCHARGE of Columbia River, at Golden, for 1910.

DAY.	APRIL.		MAY.		JUNE.		JULY.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	.....	6·8	6,300	4·4	11,000	4·0	12,000
2	.....	.....	6·8	6,300	4·6	10,600	4·0	12,000
3	.....	.....	7·5	5,200	4·7	10,400	4·1	11,800
4	.....	.....	7·7	4,900	4·8	10,200	4·1	11,800
5	.....	.....	7·8	4,800	4·8	10,200	4·1	11,800
6	10·8	1,850	7·8	4,800	4·9	9,900	4·1	11,800
7	10·7	1,900	7·5	5,200	4,8	10,200	4·0	12,000
8	10·8	1,850	7·3	5·500	4·7	10,400	3·9	12,300
9	10·7	1,900	6·7	6,500	4·8	10,200	3·8	12,500
10	10·6	1,950	6·3	7,200	4·7	10,400	3·8	12,500
11	10·5	2,050	6·2	7,300	4·5	10,800	3·8	12,500
12	10·2	2,200	6·0	7,700	4·2	11,600	3·8	12,500
13	9·8	2,500	5·9	7,900	4·2	11,600	3·8	12,500
14	9·7	2,600	5·8	8,100	4·2	11,600	3·7	12,800
15	9·8	2,500	5·7	8,300	4·2	11,600	3·7	12,800
16	10·0	2,350	5·9	7,900	4·0	12,000	3·7	12,800
17	10·1	2,300	6·0	7,700	3·8	12,500	3·7	12,800
18	10·0	2,350	6·2	7,300	3·7	12,800	3·6	13,100
19	9·9	2,450	6·3	7,200	3·7	12,800	3·5	13,300
20	9·7	2,600	6·3	7,200	3·6	13,100	3·4	13,600
21	9·6	2,700	6·3	7,200	3·5	13,300	.....	.....
22	9·4	2,900	6·3	7,200	3·6	13,100	.....	.....
23	9·1	3,150	6·3	7,200	3·7	12,800	.....	.....
24	9·0	3,300	6·1	7,500	3·8	12,500	.....	.....
25	8·7	3,650	5·8	8·100	3·9	12,300	.....	.....
26	8·1	4,400	5·3	9,100	3·9	12,300	.....	.....
27	7·7	4,900	5·0	9,700	4·0	12,000	.....	.....
28	7·2	5,700	4·8	10,200	4·0	12,000	.....	.....
29	7·0	6,000	4·7	10,400	4·0	12,000	.....	.....
30	6·7	6,500	4·4	11,000	4·2	11,600	.....	.....
31	.....	.....	4·3	11,300	.....	.....	.....	.....

MONTHLY DISCHARGE of Columbia River, at Golden, for 1910.

(Drainage area, 2,500 square miles.)

Month.	DISCHARGE IN SECOND FEET.				RUN-OFF.	
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
April	6,500	1,850	3,000	1·2	1·3	178,500
May	11,300	4,800	7,491	3·0	3·5	460,500
June	13,300	9,900	11,593	4·64	5·2	684,300
July	13,600	11,800	13,000	5·2	6·0	799,300

NOTE.—No records after July.
Accuracy "A." up to 12,000 c.f.s.; "B." over 12,000 c.f.s.

DAILY GAUGE HEIGHT AND DISCHARGE

Day.	APRIL.		MAY.		JUNE.		JULY.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Dischatge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	.....	10·5	2,050	8·0	4,500	2·2	17,100
2	.....	.....	10·3	2,150	7·8	4,800	2·3	16,800
3	.....	.....	10·0	2,350	7·5	5,200	2·3	16,800
4	.....	.....	9·7	2,600	7·3	5,500	2·5	16,200
5	.....	.....	9·5	2,800	6·0	7,700	2·7	15,600
6	.....	.....	9·3	3,000	5·9	7,900	2·9	15,100
7	.....	.....	9·2	3,050	5·7	8,300	3·0	14,800
8	.....	.....	9·1	3,150	5·7	8·300	3·2	14,200
9	.....	.....	9·1	3,150	5·7	8·300	3·3	13,900
10	.....	.....	9·1	3,150	5·7	8,300	3·4	13,600
11	.....	.....	9·2	3,050	5·7	8,300	3·6	13,100
12	.....	.....	9·3	3,000	5·6	8,500	3·7	12,800
13	.....	.....	9·3	3,000	5·2	9,300	4·0	12,000
14	.....	.....	9·2	3,050	4·9	9,900	4·0	12,000
15	.....	.....	9·1	3,150	4·6	10,600	4·2	11,600
16	.....	.....	8·8	3,500	4·4	11,000	4·2	11,600
17	.....	.....	8·7	3,650	4·1	11,800	4·2	11,600
18	.....	.....	8·5	3,900	3·1	14,500	4·2	11,600
19	11·4	1,575	8·5	3,900	3·3	13,800	4·2	11,600
20	11·4	1,575	8·5	3,900	2·9	15,100	4·2	11,600
21	11·4	1,575	8·7	3,650	2·8	15,300	4·2	11,600
22	11·4	1,575	8·7	3,650	2·5	16,200	4·1	11,800
23	11·4	1,575	8·8	3,500	2·3	16,800	4·2	11,600
24	10·7	1,900	8·8	3,500	2·1	17,500	4·2	11,600
25	10·1	2,300	8·8	3,500	2·0	17,800	4·1	11,800
26	10·2	2,200	9·1	3,150	1·9	18,100	4·1	11,800
27	10·5	2,050	9·1	3,150	1·9	18,100	4·1	11,800
28	10·7	1,900	9·1	3,150	2·0	17,800	4·1	11,800
29	10·8	1,850	9·1	3,150	2·1	17,500	4·1	11,800
30	10·8	1,850	9·0	3,300	2·2	17,100	4·1	11,800
31	.....	.....	8·4	4,000	.....	.....	4·2	11,600

DAILY GAUGE HEIGHTS AND DISCHARGE of Columbia River, at Golden, for 1910.

AUGUST.		SEPTEMBER.		OCTOBER.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
4·3	11,300	7·3	5,500	10·3	2,150	1
4·4	11,000	7·1	5,800	10·4	2,100	2
4·4	11,000	7·0	6,000	10·4	2,100	3
4·5	10,800	7·0	6,000	10·4	2,100	4
4·6	10,600	6·9	6,100	10·4	2,100	5
4·8	10,200	7·0	6,000	10·5	2,050	6
5·0	9,700	7·2	5,700	10·6	1,950	7
5·1	9,500	7·5	5,200	10·6	1,950	8
5·2	9,300	7·1	5,800	10·6	1,950	9
5·2	9,300	8·3	4,100	10·6	1,950	10
5·3	9,100	8·5	3,900	10·6	1,950	11
5·4	8,900	8·5	3,900	10·6	1,950	12
5·6	8,500	8·3	4,100	10·7	1,900	13
5·8	8,100	8·2	4,250	10·7	1,900	14
5·9	7,900	8·2	4,250	10·8	1,850	15
6·0	7,700	8·1	4,400	10·8	1,850	16
6·1	7,500	8·5	3,900	10·8	1,850	17
6·2	7,300	9·1	3,150			18
6·3	7,200	9·3	3,000			19
6·4	7,000	9·5	2,800			20
6·4	7,000	9·7	2,600			21
6·5	6,800	9·7	2,600			22
6·6	6,700	9·8	2,500			23
6·7	6,500	9·9	2,450			24
6·8	6,300	10·0	2,350			25
7·0	6,000	10·1	2,300			26
7·2	5,700	10·2	2,200			27
7·3	5,500	10·2	2,200			28
7·4	5,400	10·2	2,200			29
7·4	5,400	10·3	2,150			30
7·4	5,400					31

MONTHLY DISCHARGE of Columbia River, at Golden, for 1911.

(Drainage area, 2,500 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.	
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
April	2,300	1,400	1,500	0·6	0·7	89,200
May	4,000	2,050	3,201	1·8	1·5	196,800
June	18,100	4,500	11,793	4·71	5·3	701,700
July	17,100	11,600	12,987	5·19	6·0	798,500
August	11,300	5,400	8,019	3·21	3·7	493,000
September	6,100	2,150	3,913	1·57	1·7	232,800
October	2,150	1,850	1,900	0·76	0·9	116,800

NOTE.—Accuracy "A" up to 12,000 c.f.s.; "B" over 12,000 c.f.s.

DAILY GAUGE HEIGHT AND DISCHARGE

Day.	APRIL.		MAY.		JUNE.		JULY.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			11·3	1,625	8·4	4,000	4·2	11,600
2			11·3	1,625	8·7	3,650	4·2	11,600
3			11·0	1,750	9·2	3,050	4·2	11,600
4			11·2	1,650	9·2	3,050	4·3	11,300
5			11·2	1,650	9·6	2,700	4·4	11,000
6	10·4	2,100	11·2	1,650	9·4	2,900	4·7	10,400
7	10·4	2,100	11·1	1,700	9·1	3,150	4·8	10,200
8	10·5	2,050	11·0	1,750	8·4	4,000	4·8	10,200
9	10·5	2,050	10·8	1,850	9·1	3,150	4·9	9,900
10	10·7	1,900	10·5	2,050	8·8	3,500	4·9	9,900
11	10·8	1,850	10·2	2,200	8·6	3,750	5·0	9,700
12	11·0	1,750	10·0	2,350	7·9	4,650	5·2	9,300
13	11·2	1,650	9·8	2,500	7·6	5,000	5·3	9,100
14	11·3	1,625	9·7	2·600	6·5	6·800	5·3	9,100
15	11·3	1,625	9·2	3,050	6·0	7,700	5·3	9·100
16	11·4	1,575	8·5	3,900	6·0	7,700	5·3	9,100
17	11·4	1,575	8·0	4,500	6·0	7,700	5·3	9,100
18	11·4	1,575	7·8	4,800	6·0	7,700	5·2	9,300
19	11·4	1,575	7·9	4,650	5·8	8,100	5·2	9,300
20	11·3	1,625	7·9	4,650	5·8	8,100	5·2	9,300
21	11·3	1,625	7·9	4,650	5·6	8,500	5·2	9,300
22	11·3	1,625	7·9	4,650	5·4	8,900	5·3	9·100
23	11·3	1,625	8·0	4,500	5·3	9,100	5·3	9,100
24	11·3	1,625	8·3	4,100	5·1	9,500	5·3	9·100
25	11·3	1,625	8·5	3,900	4·8	10,200	5·4	8,900
26	11·3	1,625	8·7	3,650	4·7	10,400	5·4	8,900
27	11·4	1,575	8·9	3,400	4·7	10,400	5·5	8,700
28	11·3	1,625	8·5	3,900	4·5	10,800	5·5	8,700
29	11·3	1,625	8·3	4,100	4·4	11,000	5·6	8,500
30	11·5	1,550	8·1	4,400	4·2	11,600	5·6	8,500
31			8·0	4,500			5·6	8,500

SESSIONAL PAPER No. 25f

of Columbia River, at Golden, for 1912.

August.		September.		October.		November.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
5·7	8,300	8·2	4,250	10·5	2,050	11·6	1,500	1
5·7	8,300	8·3	4,100	10·5	2,050	11·6	1,500	2
5·7	8,300	8·3	4,100	10·5	2,050	11·6	1,500	3
5·6	8,500	8·5	3,900	10·4	2,100			4
5·4	8,900	9·0	3,300	10·4	2,100			5
5·3	9,100	9·0	3,300	10·4	2,100			6
5·3	9,100	9·1	3,150	10·5	2,050			7
5·4	8,900	9·2	3,050	10·5	2,050			8
5·6	8,500	9·3	3,000	10·5	2,050			9
5·7	8,300	9·3	3,000	10·6	1,950			10
5·8	8,100	9·3	3,000	10·7	1,900			11
5·8	8,100	9·3	3,000	10·7	1,900			12
5·8	8,100	9·4	2,900	10·8	1,850			13
5·8	8,100	9·4	2,900	10·8	1,850			14
5·9	7,900	9·4	2,900	10·8	1,850			15
6·0	7,700	9·4	2,900	10·8	1,850			16
6·0	7,700	9·5	2,800	10·7	1,900			17
6·2	7,300	9·5	2,800	10·7	1,900			18
6·3	7,200	9·5	2,800	10·7	1,900			19
6·3	7,200	9·5	2,800	10·6	1,950			20
6·4	7,000	9·5	2,800	10·7	1,900			21
6·4	7,000	9·5	2,800	10·8	1,850			22
6·5	6,800	9·6	2,700	10·8	1,850			23
6·5	6,800	9·6	2,700	10·8	1,850			24
6·7	6,500	9·6	2,700	10·8	1,850			25
6·7	6,500	9·7	2,600	10·9	1,800			26
7·1	5,800	9·7	2,600	10·9	1,800			27
7·3	5,500	9·9	2,450	11·0	1,750			28
7·7	4,900	10·0	2,350	11·1	1,700			29
7·8	4,800	10·2	2,200	11·3	1,625			30
8·0	4,500			11·5	1,550			31

MONTHLY DISCHARGE of Columbia River, at Golden, for 1912.

(Drainage area, 2,500 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.	
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
April.....	2,100	1,550	1,750	0·7	1·8	104,100
May.....	4,800	1,625	3,169	1·27	1·5	195,000
June.....	11,600	2,700	6,725	2·69	3·0	399,900
July.....	11,600	8,500	9,594	3·84	4·4	589,700
August.....	9,100	4,500	7,732	3·09	3·6	475,300
September...	4,250	2,200	2,995	1·2	1·3	177,500
October....	2,100	1,550	1,900	0·76	0·9	116,800

NOTE.—River froze on November 4. Minimum discharge for 1912 occurred February 20, and was 795 c.f.s.
Accuracy "A" up to 12,000 c.f.s.; "B" over 12,000 c.f.s.

COLUMBIA RIVER (FROM GOLDEN TO REVELSTOKE).

Columbia river from Golden to Surprise rapids, at the north limit of the Railway Belt, is navigable for small boats, there being a small rapid between Donald and Beavermouth. In fact, the river can be run by boats and canoes almost to Revelstoke, but it is rather a dangerous trip.

Between Beavermouth and Surprise rapids the river runs through a valley somewhat similar to the upper Columbia valley above Golden, with side channels and sloughs.

There is not much agricultural land between Golden and Revelstoke, except heavily timbered country, and there are but few settlers. Valuable timber is found along the valley and the many tributaries. Some mining is carried on, but the copper and galena ores do not pay very well on account of their low grade and the lack of transport facilities. In the Selkirks lying in the embrace of the Columbia to the 'Big Bend,' are found valuable mica deposits.

The important tributaries of Columbia river from Golden to Revelstoke are: Kicking Horse river, Blaeberry river, Bluewater river, Waitabit creek, Beaver river, Gold creek and Bush river, all within the Railway Belt. Then there are Wood river, Canoe river, Downie creek, Gold stream, and many other smaller tributaries. Coming into the Railway Belt again, above Revelstoke, we have Carnes creek, LaForme creek and Jordan river.

There are numerous falls and rapids, the principal one being about four miles above Revelstoke. With a head of 25 feet considerable power could be developed, but it would involve great expense.

A powerful flat bottom steamer navigates the Columbia from just above Revelstoke to Priest rapids above Downie creek.

Columbia valley from Revelstoke through the 'Big Bend' has a humid climate, with a precipitation of from 40 to 100 inches, mostly snowfall in the lofty mountains, especially in the Selkirks.

Below Revelstoke the Columbia is navigable, and large C.P.R. steamers ply on the Arrow lakes.

COLUMBIA RIVER (AT REVELSTOKE) (401).

The station on Columbia river at Revelstoke was established on October 12, 1911, by C. E. Richardson.

The measuring section is located on the traffic bridge immediately below the C. P. R. bridge and about 1½ miles from the C. P. R. station at Revelstoke. Illecillewaet river empties into the Columbia about one mile below the gauging station.

The gauge is a chain gauge. From tip to tip the length is 55·53 feet. The graduations from 0 to 20 feet are located on the handrail on the downstream side of the bridge, about 75 feet from the near side of the bridge approaching from town.

Measurements are made from the upstream side of the bridge. About 90 feet of cable is needed to suspend the meter, and 15 pounds of lead generally used, but at high water 30 pounds are necessary. At extreme high water the current is so fast that it is difficult to sink the meter to the required depths, and surface velocities have to be taken.

The initial point for soundings is at the left abutment of the bridge (looking downstream), on the upstream side of the bridge. The point is marked on the handrail in blue paint.

The channel above the station is straight for about 300 yards, and below the station is straight for 800 yards. The river broadens below the station. The water is fairly swift. There are a few eddies around some of the piers. The right bank is low and at very high water is flooded, but only a small percentage of the water flows over the sandbars. The left bank is about 60 feet high. The bed of the stream is sand and gravel and is liable to shift. At low water the river flows through five piers, and through seven at high water. The river varies from 25 to 35 feet in depth in the deepest channel. The difference between high and low water level on an average year is about 9 feet, but it was about 11 feet higher than the average in the famous flood year of 1894.

The high-water mark of 1894 is equivalent to 24·01 feet on the hydrographic survey gauge.

Three bench-marks were established to which the datum of the gauge was referred.

DISCHARGE MEASUREMENTS of Columbia River, at Revelstoke, B.C., for 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
1911.							
Oct. 12..	C. E. Richardson.	1,048	700	4,990	2·7	5·45	13,300
1912.							
Feb. 27..	"	1,048	460	3,170	1·4		4,460
Apr. 19.	"	1,048	710	5,140	2·6	5·54	13,000
May 22.	(H. C. Hughes)	1,055	840	8,280	5·0	11·8	41,500†
June 18..	"	1,048	960	12,500	7·8	15·5	96,900
June 24..	"	1,048	1,010	15,700	8·6	18·2	135,000
Aug. 20..	"	1,048	840	10,200	6·4	12·75	65,500
Sept. 14.	"	1,055	820	7,570	4·8	9·2	36,400
Oct. 4...	"	1,055	710	6,230	3·1	7·3	19,700

NOTE.—In all widths, except in measurements, under ice-cover, the width of five piers is included.
*Ice-cover.
†Meter out of order.

DAILY GAUGE HEIGHT AND DISCHARGE of

Day.	FEBRUARY.		MARCH		APRIL.		MAY.		JUNE.		JULY.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1							6·4	17,000	9·6	37,000	14·3	81,600
2							6·5	17,500	9·7	37,750	14·3	81,600
3							6·55	17,750	9·7	37,750	14·4	82,800
4							6·7	18,500	10·1	40,850	14·3	81,600
5							6·8	19,000	11·4	52,300	14·2	80,400
6							6·9	19,500	12·2	59,900	14·4	82,800
7					4·0	8,500	7·0	20,000	12·8	65,600	14·1	79,200
8					3·8	8,000	8·2	26,900	13·1	68,550	13·7	74,850
9					4·0	8,500	8·7	30,400	13·2	69,600	13·4	71,700
10					4·15	8,950	8·7	30,400	13·8	75,900	14·1	79,200
11					4·3	9,400	8·7	30,400	14·8	87,600	14·0	78,000
12					4·6	10,300	8·6	29,700	14·7	86,400	14·1	79,200
13					4·7	10,600	9·1	33,250	14·3	81,600	14·9	88,800
14					5·2	12,200	10·0	40,000	13·8	75,900	14·3	81,600
15			4·0	8,500	5·25	12,375	11·4	52,300	13·2	69,600	14·3	81,600
16			3·9	8,250	5·5	13,250	12·5	62,750	13·9	76,950	13·8	75,900
17			3·9	8,250	5·5	13,250	12·35	61,325	14·7	86,400	13·5	72,750
18			3·9	8,250	5·5	13,250	11·7	55,150	15·5	96,250	13·6	73,800
19			4·0	8,500	5·6	13,600	10·9	47,650	16·1	103,950	13·8	75,900
20			3·95	8,375	5·7	13,950	11·1	49,450	16·8	114,100	14·1	79,200
21			3·9	8,250	5·9	14,650	11·4	52,300	17·4	122,800	14·2	80,400
22			3·8	8,000	5·95	14,825	11·8	56,100	17·8	128,600	14·2	80,400
23			3·95	8,375	6·1	15,500	12·0	58,000	18·2	134,400	14·1	79,200
24			3·8	8,000	6·1	15,500	12·1	58,950	18·1	152,950	14·0	78,000
25				8,150	6·0	15,000	12·1	58,950	18·3	135,850	14·5	84,000
26			3·92	8,300	6·05	15,250	12·4	61,800	18·7	141,650	14·2	80,400
27		4,460	3·9	8,250	6·0	15,000	12·8	65,600	17·8	128,600	13·7	74,850
28			3·9	8,250	6·0	15,000	12·8	65,600	15·7	98,750	13·2	69,600
29				8,525	6·1	15,500	11·7	55,150	14·5	84,000	13·7	74,850
30			4·1	8,800	6·2	16,000	10·9	47,650	14·5	84,000	13·7	74,850
31							10·2	41,700			14·3	81,600

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Columbia River, at Revelstoke, B.C., for 1912.

August.		September.		October.		November.		December.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
14·4	82,800	9·9	39,750	..	16,500	5·4	12,900	4·3	9,400	1
14·6	85,000	9·4	35,500	..	16,500	5·3	12,550	4·4	9,700	2
14·8	87,600	9·0	32,500	.	16,500	5·3	12,550	4·7	10,600	3
15·0	90,000	8·7	30,400	. .	16,500	5·3	12,550	5·1	11,850	4
15·7	98,750	8·7	30,400	.....	16,500	5·2	12,200	. . .	11,700	5
14·8	87,600	8·6	29,700	..	16,500	5·2	12,200	5·0	11,500	6
13·7	74,850	8·5	29,000	.....	16,500	5·1	11,850	4·8	10,900	7
13·5	72,750	8·5	29,000	. .	16,500	5·1	11,850	4·5	10,000	8
14·2	80,400	8·5	29,000	. .	16,500	5·2	12,200	4·3	9,400	9
14·5	84,000	9·0	32,500	.	16,500	5·1	11,850	4·3	9,400	10
14·3	81,600	9·1	33,250		16,500	5·0	11,500	4·2	9,100	11
13·8	75,900	9·1	33,250	. . . .	16,500	4·9	11,200	4·1	8,800	12
12·7	64,650	9·3	34,750	.....	16,500	4·9	11,200	4·2	9,100	13
12·5	62,750	9·2	34,000		16,500	4·8	10,900	4·3	9,400	14
12·8	65,600	8·7	30,400	. .	16,500	4·8	10,900	4·3	9,400	15
13·7	74,850	8·4	28,300		16,500		10,900			16
12·8	65,600	8·3	27,600		16,500	.	10,900			17
12·7	64,650	8·1	26,200		16,500	4·8	10,900			18
12·7	64,550	8·0	25,500		16,500	4·9	11,200			19
12·8	65,600	8·0	25,500		16,500	5·1	11,850			20
13·3	70,650	7·9	24,950	6·4	17,000	5·1	11,850			21
14·0	78,000	7·4	22,200	6·4	17,000	5·0	11,500			22
14·9	88,800	7·2	21,100	6·3	16,500	5·0	11,500			23
16·1	103,950	7·1	20,550	6·0	15,000	5·1	11,850			24
15·8	100,000	6·9	19,500	5·7	13,950	5·0	11,500			25
14·7	86,400	6·7	18,500	5·6	13,600	5·0	11,500			26
13·7	74,850	6·4	17,000	5·5	13,250	4·8	10,900			27
12·7	64,650	6·4	17,000	5·6	13,600	4·6	10,300			28
12·0	58,000	6·3	16,500	5·6	13,600	4·5	10,000			29
10·9	47,650	6·2	16,000	5·5	13,250	4·4	9,700			30
10·5	44,250			5·4	12,900					31

MONTHLY DISCHARGE of Columbia River, at Revelstoke, for 1912.

(Drainage area, 9,000 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
March	8,800	5,000	7,280	0·8	0·9	448,000
April	16,000	8,000	12,000	1·3	1·45	714,000
May	65,600	17,000	42,000	4·7	5·4	2,580,000
June	142,000	37,000	87,000	9·7	10·8	5,190,000
July	88,800	71,700	78,700	8·7	10·0	4,840,000
August	104,000	44,200	75,700	8·4	9·7	4,650,000
September	39,250	16,000	27,000	3·0	3·3	1,610,000
October	17,000	12,900	15,795	1·75	2·02	971,000
November	12,900	9,700	11,492	1·28	1·43	684,000

NOTE.—Station established October 12, 1911. Freeze-up occurred November 5, 1911. Channel opened March 1, 1912. Freeze-up occurred middle of December, 1912.
Accuracy, "A."

COLUMBIA RIVER AT ATHALMER (404).

The station on Columbia river at Athalmer, B.C., was established on May 28, 1912, by C. E. Richardson, assisted by H. C. Hughes. The measuring section is located on the upstream side of the highway bridge, about 100 yards below lake Windermere, at the town of Athalmer. Toby creek empties into the Columbia about 1 mile below the station. The gauge is a vertical staff 2 inches by 4 inches by 4 feet, marked in feet and tenths in black paint. It is fastened to a pile on the left side of the stream (looking downstream), beneath the above-mentioned bridge. Measurements were made with Price's Electric Current Meter (small) and 6½ pounds of lead suspended by a cable. The initial point for sounding is located at the left abutment of the bridge on the downstream side. The channel above and below the section is straight for 100 yards and the water is sluggish except during high water on lake Windermere. At all stages the river is confined between the abutments of the bridge. The bed of the stream on the left side is gravelly and clean, suitable for navigation during the summer months. On the right side the stream is shallow, sluggish and filled with vegetation.

The fall between the gauging section and the mouth of Toby creek, one mile downstream, is very small, and when Toby creek has its freshet flow the water is backed up on the gauge. In extreme cases the flow in Columbia river is reversed and logs driven down Toby creek have been carried into lake Windermere. So at Athalmer, as at Spillimacheen, the gauge readings are only of value in connection with navigation and the proposed reclamation of the overflow land in the Upper Columbia valley.

The following bench-marks were located with reference to the gauge datum:—

B.M. No. 1.—Located on an electric light pole on the left bank, immediately below the bridge. Elevation 7·96.

B.M. No. 2.—Located on a cribbing on the left bank about 35 feet above the bridge. Elevation 4·79.

B.M. No. 3.—Located on the left bridge abutment on the upstream side of the bridge. Elevation 6·26.

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DISCHARGE MEASUREMENTS of Columbia River, at Athalmer, B.C., for 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
1912.							
May 28	H. C. Hughes	1055	121	238	1·46	2·30	340
June 12	"	1055	149	364	1·05	3·39	382
" 29	"	1055	157	614	1·91	5·06	1,180
July 22	"	1055	160	580	1·56	4·52	902
Sept. 28	C. Richardson	1055	137	240	1·71	2·43	410

MEAN DAILY GAUGE HEIGHT, in feet, of Columbia River, at Athalmer, for June, July, August and September 1912.

Day.	June.	July.	August.	September.
1	2·3	4·8	4·42	3·31
2	2·32	4·84	4·43	3·22
3	2·34	4·7	4·47	3·16
4	2·25	4·62	4·5	3·17
5	2·26	4·66	4·4	3·05
6	2·4	4·62	4·27	3·0
7	2·55	4·6	4·25	2·92
8	2·84	4·6	4·18	2·92
9	2·95	4·57	4·16	2·92
10	3·06	4·56	4·16	2·91
11	3·15	4·52	4·16	2·86
12	3·36	4·41	4·13	2·85
13	3·57	4·75	4·02	2·8
14	3·61	4·82	3·92	2·75
15	3·68	4·68	3·9	2·7
16	3·62	4·68	3·9	2·7
17	3·78	4·61	3·82	2·67
18	3·95	4·53	3·77	2·65
19	4·15	4·55	3·7	2·6
20	4·33	4·56	3·77	2·6
21	4·53	4·53	3·66	2·55
22	4·71	4·57	3·72	2·55
23	4·97	4·51	3·78	2·55
24	5·1	4·5	3·82	2·52
25	5·25	4·48	3·85	2·5
26	5·32	4·46	3·75	2·5
27	5·47	4·42	3·61	2·5
28	5·37	4·38	3·56	2·5
29	5·02	4·37	3·5	2·47
30	4·95	4·42	3·46	2·35
31		4·42	3·42	

COLUMBIA RIVER AT SPILLIMACHEEN (403.)

The station on Columbia river at Spillimacheen was established on June 2, by H. C. Hughes. The measuring section is located on the downstream side of the highway bridge on the road from Spillimacheen Landing to Spillimacheen river, Bugaboo river and the west side of the upper valley. Lake Windermere is 40 miles south, and Golden is 40 miles north. The gauge is a vertical staff, 2 inches by 4 inches by 13 feet (cedar) marked in feet and tenths in black paint. It is fastened to the upstream end of a wharf on the west bank of the river, about 300 feet below the bridge. There is

another (private) gauge fastened to the same wharf some 20 feet downstream, on which readings have been taken for some years by H. G. Low. Measurements were made with Price's Electric Current Meter (small) and 6½ pounds weight suspended by a cable. The initial point for sounding is at the right abutment of the bridge (looking downstream) on the downstream side. The channel above and below the gauging section is straight for 200 feet; the water is sluggish. At low water the river is confined between the bridge abutment, but at high water the surrounding flats are covered, and two or three small side channels exist. These flats are covered with small underbrush. The bed of the stream is silt and is liable to shift. The depth varies from 10 feet to 25 feet.

Spillimacheen river flows into the Columbia about 1 mile below the gauging section, and when it is in flood it backs up water to the gauge. Gauge readings, however, were taken in the summer of 1912 to determine the rise and fall of the river. These may be found of value with reference to navigation and the proposed reclamation scheme to reclaim some 50,000 acres of overflow land in Upper Columbia valley.

The following bench-marks were established with reference to the gauge datum:—

B.M. No. 1.—Located on the southeast corner of the wharf, to which the gauge is attached. Elevation 11·56.

B.M. No. 2.—Located on a pile, 15 feet upstream from the above-mentioned wharf. Elevation 12·16.

B.M. No. 3.—Located on a cottonwood tree opposite the wharf, 30 feet from the water. Elevation 14·58.

The zero of H. G. Low's gauge is 1'·62 above the zero of the Hydrographic Survey gauge.

DISCHARGE MEASUREMENTS of Columbia River, at Spillimacheen, 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
1912.							
May 30.....	H. C. Hughes.....	1055	163	1,760	1·14	3·55	2,000
June 17.....	"	1055	230	2,550	1·69	7·78	4,300
June 20.....	"	1055	230	2,710	1·79	8·54	4,860
July 4.....	"	1055	235	2,820	2·21	8·64	6,230
July 17.....	"	1055	230	2,760	2·17	8·36	6,000
Sept. 30.....	C. E. Richardson.....	1055	140	1,510	0·80	3·02	1,210

NOTE.—Gauge heights are affected by backwater from the Spillimacheen river, which empties into the Columbia about 1 mile below the gauging section.

MEAN DAILY GAUGE HEIGHT, in feet of Columbia River, Spillimacheen, June 2 to October 2, 1912.

Day.	June.	July.	August.	September.	October.
1		9·4	8·1	6·0	3·0
2	4·52	9·2	8·2	5·6	3·0
3	4·4	9·1	8·3	5·4	
4	4·3	8·75	8·4	5·3	
5	4·15	8·5	8·85	5·2	
6	4·15	8·5	8·5	4·9	
7	4·5	8·4	8·2	4·8	
8	5·5	8·3	8·0	4·7	
9	6·5	8·3	8·0	4·6	
10	6·8	8·3	8·0	4·5	
11	6·9	8·3	8·0	4·4	
12	7·0	8·3	7·8	4·2	
13	7·7	8·3	7·4	4·6	
14	7·95	8·4	7·1	4·6	
15	7·75	8·4	6·9	4·3	
16	7·4	8·4	7·2	4·2	
17	7·5	8·4	7·1	4·1	
18	7·7	8·4	6·8	4·1	
19	8·0	8·3	6·7	4·0	
20	8·5	8·3	6·2	3·9	
21	8·7	8·3	6·4	3·8	
22	9·0	8·3	6·8	3·7	
23	9·4	8·3	7·4	3·6	
24	9·7	8·3	7·7	3·6	
25	9·9	8·2	8·1	3·5	
26	10·1	8·1	7·9	3·4	
27	10·35	8·0	7·5	3·3	
28	10·3	7·8	7·3	3·2	
29	10·0	7·8	6·8	3·1	
30	9·7	8·0	6·7	3·0	
31		8·1	6·3		

COQUIHALLA RIVER (119).

Coquihalla river has its source in the pass between Coquihalla and Coldwater rivers, at an elevation of 3,000 feet, and discharges into Fraser river near Hope, at an elevation of 120 feet. It is part of the Fraser drainage; the drainage area, as measured from a Dominion sectional map, scale 3 miles to an inch, is 360 square miles. The annual precipitation varies from 50 inches at the mouth to about 80 inches at the head-waters, where the winters are more severe.

The following tributaries enter from the left going upstream, Kawkawa, Ladner, and Boston Bar creeks, while Nicolum creek and Pierre river enter from the right. Just above the mouth of the Nicolum, about six miles from the mouth of the Coquihalla, is the site of a proposed power development, about 1½ acres in extent. The river flows through a gorge with precipitous rocky walls from 30 to 70 feet in width, and about 150 feet in height. By constructing a dam at the head of the gorge, and a tunnel through the mountains for about 1,000 feet to the power site, a head of from 100 to 125 feet could be obtained. Storage facilities, however, are indefinite yet, and may be limited by the railroad construction in the valley. A few hundred feet below the mouth of the Nicolum, there is another small canyon and falls; but to use this section of the river in conjunction with the other would be very expensive.

The river station on the Coquihalla was established April 10, 1912, by C. G. Cline. It is located at the upper highway bridge, a mile from the mouth. A chain gauge 24 feet long is attached to the middle of the bridge on the downstream side, and its datum is referred to three bench-marks. Cable measurements are made from

the downstream side of the bridge. This makes a good measuring section, the control is good, the banks are high, the current uniform, and a rocky permanent channel bed. In very high water the river might flow in two channels, but entirely under the bridge.

DISCHARGE MEASUREMENTS of Coquihalla River, near Hope, B.C., 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
1911.							
Nov. 16	C. G. Cline	1053	75	146	2·3	1·15	*330
Dec. 12	K. H. Smith	1057	100	285	4·3	2·05	*1,219
1912.							
Feb. 29	C. G. Cline	1046	95	174	2·4	1·25	*422
June 8	Cline and Corbould	1046	149	597	4·8	3·30	†2,880
June 29	C. G. Cline	1046	122	275	3·2	1·90	†890
Sept. 13	"	1046	110	171	2·0	1·05	†334
Nov. 15	"	1048	120	276	2·8	1·65	†760
Nov. 18	"	1048	120	350	3·5	2·25	†1,210
Nov. 20	"	1048	120	386	3·9	2·45	†1,510

*These measurements apply to curve No. 1. Gauge destroyed and section altered.
†These measurements apply to curve No. 8. Chain gauge was established April 10.

DAILY GAUGE HEIGHT AND DISCHARGE of Coquihalla River, near Hope, B. C., for 1911.

Day.	November.		December.	
	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·8	950
2			1·8	950
3				900
4			1·7	850
5			1·7	850
6			1·6	750
7			1·6	750
8				750
9			1·6	750
10			1·8	950
11			2·0	1,160
12			1·9	1,050
13				1,000
14			1·8	950
15			1·8	950
16	1·1	310	1·8	950
17	2·3	1,500		800
18	3·95	3,560	1·5	650
19	4·0	3,630	1·5	650
20	2·9	2·210	1·5	650
21	2·6	1,850	1·5	650
22	2·25	1,440		910
23	2·1	1,270	2·0	1,160
24	1·95	1,100		1,000
25	2·3	1,500	1·7	850
26	2·0	1,160	1·6	750
27	1·95	1,100	1·5	650
28	1·80	950	1·5	650
29	1·80	950		560
30	1·80	950	1·3	470
31				470

MONTHLY DISCHARGE of Coquihalla River, near Hope, B. C., for 1911.

(Drainage area, 360 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
November	3,630	310	*1,000	2·8	3·1	59,500	
December	1,160	470	819	2·3	2·6	50,400	
The period							50 to 70

NOTE.—Accuracy, "A" and "C."
*Estimated.

Daily Gauge Height and Discharge of

Day.	January.		February.		March.		April.		May.		June.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	1·3	470	2·1	1,270	1·4	560	.....	740	.....	1,150	2·7	1,730
2	.....	470	.....	1,110	.....	530	Curve.	780	2·15	1,140	2·8	1,850
3	.....	470	1·8	950	.....	500	No. 2	820	.....	1,140	2·65	1,670
4	1·3	470	.....	900	1·3	470	.....	860	2·15	1,140	.....	2,010
5	.....	500	1·7	850	.....	430	.....	900	.....	1,480	3·2	2,360
6	.....	530	.....	850	1·2	390	.....	930	.....	1,810	3·35	2,570
7	1·4	560	.....	850	.....	390	.....	970	3·05	2,150	.....	2,750
8	.....	560	1·7	850	1·2	390	.....	1,010	.....	2,740	3·6	2,940
9	.....	560	.....	900	.....	370	.....	1,050	3·85	3,330	.....	2,720
10	1·4	560	1·8	950	.....	350	2·1	1,090	3·35	2,570	3·3	2,500
11	1·4	560	.....	1,050	.....	330	.....	955	3·35	2,570	3·25	2,430
12	.....	1,090	2·0	1,160	1·1	310	1·8	830	.....	3,050	3·3	2,500
13	2·4	1,610	.....	1,160	.....	310	1·8	830	3·97	3,540	3·25	2,430
14	2·8	2,090	2·0	1,160	.....	310	1·8	830	5·02	5,600	3·05	2,150
15	2·4	1,610	2·0	1,160	.....	310	.....	830	4·75	5,020	2·8	1,850
16	.....	1,390	2·1	1,270	1·1	310	.....	830	4·15	3,860	.....	2,140
17	.....	1,170	.....	1,210	.....	310	1·8	830	.....	2,940	3·25	2,430
18	1·8	950	2·0	1,160	1·1	310	1·7	750	2·95	2,030	3·22	2,390
19	.....	900	2·0	1,160	.....	280	1·7	750	.....	2,760	3·35	2,570
20	1·7	850	2·0	1,160	.....	260	.....	780	3·95	3,500	.....	2,460
21	1·7	850	.....	1,050	1·0	230	.....	800	3·95	3,500	3·2	2,360
22	1·7	850	1·8	950	.....	310	1·8	830	3·75	3,170	2·65	1,670
23	.....	880	.....	900	1·2	390	.....	830	.....	2,940	.....	1,730
24	.....	920	1·7	850	.....	430	1·8	830	3·45	2,710	2·75	1,790
25	1·8	950	.....	850	curve	470	.....	830	3·45	2,710	2·55	1,550
26	.....	950	1·7	850	No. 1	500	1·8	830	.....	2,710	2·55	1,550
27	1·8	950	1·6	750	.....	540	1·8	830	3·45	2,710	.....	1,320
28	.....	950	1·5	650	.....	580	.....	1,000	3·35	2,570	2·1	1,090
29	1·8	950	1·3	470	.....	620	2·2	1,190	3·05	2,150	2·02	1,020
30	2·8	2,090	.....	.....	.....	660	.....	1,180	2·85	1,910	.....	1,010
31	2·3	1,500	.....	.....	.....	700	.....	.....	2·85	1,910	.....	.....

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Coquihalla River, near Hope, B.C., for 1912.

July.		August.		September.		October.		November.		December.		Day.
Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
2·0	1,000		390		520		230		340		750	1
2·5	1,500	1·1	370	1·5	600	0·75	230	0·95	310	1·7	750	2
2·05	1,050		360	1·4	540	1·45	570		325		830	3
2·1	1,090		340		490		420		340	1·9	910	4
2·5	1,500	1·0	330		440	0·85	270		335	1·7	750	5
2·2	1,190		330	1·15	395	0·7	210	1·10	370		790	6
	1,030	1·0	330		280		375	1·10	370	1·55	635	7
1·85	870	0·95	310	1·1	370	1·40	540	1·25	455		635	8
1·9	910		425		440		450	1·30	480	1·55	635	9
1·85	870	1·4	540	1·35	510		360		810		600	10
1·85	870		480	1·3	480	0·85	270		1,140	1·45	570	11
1·8	830	1·2	430		440	0·87	280		1,470		520	12
2·4	1,390		490		400		460	2·75	1,790	1·3	480	13
1·85	870		550		360		640	2·15	1,140	1·40	540	14
1·85	870		610	0·97	320		810	1·80	830		530	15
	750	1·6	670	1·15	395		1,010	1·70	750		520	16
1·55	635	1·55	635	1·0	330	2·2	1,190		1,120	1·35	510	17
	670		670	1·0	330	1·65	710	2·5	1,500	1·5	600	18
1·65	710	1·65	710		310	1·55	635		1,470	1·5	600	19
	640		610		290		540	2·45	1,445		540	20
1·45	570	1·35	510		270		460		1,590	1·3	480	21
1·45	570	1·3	480	0·8	250	1·1	370	2·7	1,730		510	22
1·4	540		470		260		360	3·05	2,150	1·4	540	23
1·4	540	1·25	455		270	1·05	350		1,770	1·3	480	24
	545		440		280		390	2·4	1,390		480	25
1·42	550	1·2	430	0·9	290	1·2	430	2·2	1,190	1·3	480	26
1·3	480		400		270	1·2	430	2·0	1,000		495	27
1·25	455		370	0·8	250	1·2	430		920	1·35	510	28
	440	1·02	340		240		410		830		525	29
1·2	430	1·05	350	0·75	230	1·15	395	1·7	750	1·4	540	30
	410		440				365				480	31

MONTHLY DISCHARGE of Coquihalla River, near Hope, B. C., for 1912.

(Drainage area, 360 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
January	2,090	470	942	2·6	3·0	57,900	
February	1,270	470	981	2·7	2·9	56,400	
March	700	230	415	1·2	1·4	25,500	
April	1,190	740	884	2·5	2·8	52,600	
May	5,600	1,140	2,662	7·4	8·5	163,700	
June	2,940	1,010	2,059	5·7	6·4	122,600	
July	1,500	410	799	2·2	2·5	49,100	
August	710	310	460	1·3	1·5	28,300	
September	600	230	365	1·0	1·1	21,700	
October	1,190	210	471	1·3	1·5	29,000	
November	2,150	310	1,004	2·8	3·1	59,500	
December	910	480	587	1·6	1·8	36,100	
The year	5,600	210	969	2·7	36·5	702,400	50 to 70

NOTE.—The first gauge was destroyed March 23, when old bridge was torn down. New gauge established April 10. Discharges up to March 23 are from curve No. 1. From April 10 on, they are from curve No. 2. Between these two dates they are estimated. Open conditions exist all year.
Accuracy "A" up to 3,000 c.f.s.; "C" above 3,000 c.f.s.

CORNWALL CREEK (209.)

Cornwall creek rises in Cornwall lake at an elevation of 2,000 feet, and discharges into Thompson river below Ashcroft, at an elevation of 900 feet. It is part of the Thompson drainage. The area of its watershed is about 35 square miles. The water is used for irrigation, and a pipe has been laid to supply domestic water to two ranch houses. In the early days of the traffic along the Cariboo road, there was a flour-mill at Cornwall creek which was run by a large overshot water-wheel using water from the creek. The stream is in the dry belt, with a mean annual precipitation of from 8 to 10 inches.

Cornwall lake is about 2 miles long and a quarter of a mile wide. There is a dam at the outlet and it provides good storage and regulation for the creek, except that there seems to be some loss by seepage. In dry years all the water in the creek is used, and even then there is often not sufficient to irrigate the Cornwall estate, so that some years only one crop of alfalfa can be grown.

The gauging station is about 500 yards above Mr. F. V. Cornwall's house, which is on the bank of the creek, four miles from Ashcroft. The gauge is a vertical staff nailed to a tree stump 200 feet above the old diversion, on the west side of the creek. The meter measurements are made by wading. At low water they can be made at a section one foot below the gauge, but the overhanging bank prevents this at high water, and it is then necessary to go farther down the stream. The channel above the gauge is straight for 50 feet, and the water is swift. Below the gauge the channel is straight for 100 feet, with swift water. Both banks are high and wooded. The left bank overhangs the stream near the gauge, and meter measurements should not be taken there at high water. The bed of the stream is covered with gravel and rocks. There is only one channel, with the water about six inches deep. Brush jams are liable to form in the stream, and this tendency would be aided by the presence of large boulders along the bank.

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DISCHARGE MEASUREMENTS OF CORNWALL CREEK, four Miles from the Mouth, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
1911.							
Oct. 3	Cline and Smith	1046	4·5	1·9	0·3	0·81	0·54
1912.							
May 7	C. G. Cline	1046	6·0	3·15	1·1	1·0	3·5
May 12	"	1046	7·0	4·3	1·6	1·12	6·7
June 21	Cline and Corbould	1046	5·4	1·9	1·1	0·95	2·1
July 9	B. Corbould	1044	4·7	2·2	3·1	1·13	6·7
July 29	"	1044	5·5	2·8	1·3	1·0	3·6
Aug. 16	"	1044	3·5	1·6	1·1	0·91	1·8

DAILY GAUGE HEIGHT AND DISCHARGE OF CORNWALL CREEK, four Miles from Mouth, for 1911.

Day.	October.	
	Gauge height.	Discharge.
	Feet.	Sec.-ft.
1		
2		
3	0·8	0·4
4		
5		
6		
7		
8		
9	0·8	0·4
10	0·8	0·4
11	0·8	0·4
12	0·8	0·4
13	0·8	0·4
14	0·8	0·4
15		
16		
17		
18		
19		
20	0·8	0·4
21	0·8	0·4
22	0·8	0·4
23	0·8	0·4
24	0·8	0·4
25	0·8	0·4
26		
27		
28		
29		
30		
31		

DAILY GAUGE HEIGHT AND DISCHARGE of Cornwall Creek, four Miles from Mouth, for 1912.

DAY.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·9	1·7	1·1	6·0	1·0	3·5			0·9	1·7
2			0·9	1·7	1·1	6·0	1·0	3·5			0·9	1·7
3			0·9	1·7	1·1	6·0	1·0	3·5			0·9	1·7
4			0·9	1·7	1·1	6·0	1·1	6·0			0·9	1·7
5			0·9	1·7	1·1	6·0	1·1	6·0				
6			0·9	1·7	1·1	6·0						
7			1·0	3·5	1·1	6·0						
8			1·1	6·0	1·1	6·0						
9			1·1	6·0	1·1	6·0						
10			1·1	6·0	1·1	6·0						
11			1·1	6·0	1·0	3·5						
12			1·1	6·0	1·0	3·5						
13			1·2	8·8	1·0	3·5						
14			1·2	8·8	1·0	3·5						
15			1·2	8·8	1·0	3·5						
16			1·2	8·8	1·0	3·5						
17			1·2	8·8	1·0	3·5						
18			1·2	8·8	1·0	3·5						
19			1·2	8·8	1·0	3·5						
20			1·1	6·0	1·0	3·5						
21			1·2	8·8	1·0	3·5			0·9	1·7		
22	0·8	0·4	1·2	8·8	1·0	3·5			0·9	1·7		
23	0·8	0·4	1·2	8·8	1·0	3·5			0·9	1·7		
24	0·8	0·4	1·2	8·8	0·9	1·7			0·9	1·7		
25	0·8	0·4	1·2	8·8	0·9	1·7			0·9	1·7		
26	0·8	0·4	1·2	8·8	0·9	1·7			0·9	1·7		
27	0·8	0·4	1·1	6·0	0·9	1·7			0·9	1·7		
28	0·8	0·4	1·1	6·0	0·9	1·7			0·9	1·7		
29	0·9	1·7	1·1	6·0	0·9	1·7			0·9	1·7		
30	0·9	1·7	1·1	6·0	0·9	1·7			0·9	1·7		
31			1·1	6·0					0·9	1·7		

MONTHLY DISCHARGE of Cornwall Creek, four miles from Mouth, for 1912.

(Drainage area, 35 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	8·8	1·7	6·3	0·18	0·2	387	
June	6·0	1·7	3·9	0·1	0·1	232	
The period							6

NOTE.—Accuracy, "A" and "B."

Criss Creek (224.)

Criss creek has its source in the hills between the head-waters of Deadman and Tranquille rivers, at an elevation of 6,000 feet, and discharges into Deadman river, 10 miles above the mouth, at an elevation of 1,500 feet. It is part of the Thompson-Fraser drainage; the drainage area, as measured from a Geological Survey map, dated 1895, scale 2 miles to an inch, is 150 square miles. The creek flows swiftly along a narrow valley, through a rough, hilly country. The water is used for irrigation purposes, but it is only recently that the valley has become settled. There is a road for a few miles up the valley, but beyond that it is merely a pack trail. There is a quantity of small timber, which is of value to conserve the moisture and prevent erosion. Red lakes are on the south branch.

The river station on Criss creek was established June 14, 1912, by C. G. Cline. The measuring section is located about half a mile from the mouth and 400 yards above the highway bridge. Wading measurements are made at low and medium water, and at very high water cable measurements are made from the highway bridge. A standard vertical staff gauge is located on the right bank at the measuring section, and its datum is referred to three bench-marks. The measuring section is excellent; the control is good, the current uniform, the banks high, and there is one channel with a permanent bed.

Discharge Measurements of Criss Creek, near mouth, 1912.

Date.	Hydrographer.	Meter No.	Width	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
June 14..	Cline and Corbould	1046	21	47·6	2·2	1·09	107
July 16.....	B. Corbould	1044	24	31·4	1·2	0·7	38
Aug. 5...	"	1044	24	28·6	1·15	0·62	33
Aug. 30	"	1044	22	29·2	1·04	0·6	30

DAILY GAUGE HEIGHT AND DISCHARGE of Criss Creek, near mouth, for 1912.

DAY.	JUNE.		JULY.		AUGUST.		SEPTEMBER.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·9	68	0·8	52	0·6	30
2			0·85	60	0·8	52	0·65	35
3			0·85	60	0·7	40	0·9	68
4			0·82	55	0·65	35	1·0	88
5			0·8	52	0·6	30	0·9	68
6			0·85	60	0·6	30	0·9	68
7			0·85	60	0·55	26	0·85	60
8			0·85	60	0·5	22	0·8	52
9			0·8	52	0·6	30	0·9	68
10			0·75	46	0·7	40	0·85	60
11			0·75	46	0·7	40	0·8	52
12			0·7	40	0·8	52	0·7	40
13			0·8	52	0·7	40	0·8	52
14	1·09	106	0·85	60	0·6	30	0·85	60
15			0·8	52	0·55	26		
16			0·7	40	0·6	30		
17			0·6	30	0·6	30		
18			0·5	22	0·55	26		
19			0·45	19	0·55	26		
20			0·4	16	0·6	30		
21			0·3	11	0·6	30		
22			0·6	30	0·6	30		
23	0·7	40	1·8	280	0·4	16		
24	0·6	30	2·0	334	0·4	16		
25	0·57	28	1·7	254	0·4	16		
26	0·55	26	1·5	203	0·4	16		
27	0·5	22	1·3	154	0·4	16		
28	0·6	30	1·2	130	0·4	16		
29	0·65	35	1·1	108	0·55	26		
30	0·77	48	1·0	88	0·5	22		
31			0·9	68	0·6	30		

MONTHLY DISCHARGE of Criss Creek, near mouth, for 1912.

(Drainage area, 150 square miles.)

MONTH.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
July	334	11	84·2	0·56	0·65	5,180	
August	52	16	29·7	0·2	0·23	1,830	
The period							10 to 12

NOTE.—Station established June 14, and maintained during irrigation season only. Accuracy, "A" and "C."

Dairy Creek (229.)

Dairy creek has its source in the hills south of Kamloops lake at an elevation of 3,800 feet, and discharges into Cherry creek near the mouth at an elevation of 1,600 feet. It is part of the Cherry-Thompson drainage. The drainage area, as measured from the Geological Survey map, dated 1895, scale 2 miles to an inch, is 18 square miles; the drainage area above the station is 13 square miles. Dairy creek is a small irrigation stream in the heart of the Dry Belt; the summers are hot and dry, the winters long and very cold (-30° F.); the mean annual precipitation is about 10 inches.

Dairy creek is controlled by dams on two lakes about 4 miles from the source. These dams were built by the British Columbia Fruit Lands Co., and they form part of the latter's Cherry Creek irrigation system (see hydrographic description of Cherry creek). The surplus water during the freshet is stored in an artificial lake, about 3 miles from the mouth of the Creek, by the Beaton interests.

The river station on Dairy creek was established April 21, 1912, by H. J. E. Keys. The measuring section is located about 100 feet above the new channel made by the British Columbia Fruit Lands Co., just below the gauge. A standard vertical staff gauge (fir) 4 inches by 2 inches by 4 feet 5 inches is used, and all measurements are made by wading. The measuring section is excellent, there being one permanent channel, good banks, and a uniform current. The datum of the gauge is referred to three bench-marks.

Discharge Measurements of Dairy Creek, six miles south of Kamloops Lake, 1912.

Date	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
April 25	H. J. E. Keys	1057	4·3	2·4	0·41	0·8	1·0
May 18	" "	1057	3·5	4·7	3·0	1·4	14·2
June 26	" "	1057	4·0	2·2	0·6	0·85	1·3

GAUGE HEIGHTS AND DAILY DISCHARGE of Dairy Creek, six miles south of Kamloops Lake, for 1912.

Day.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·5	17·4		8·9	0·9	2·1	0·85	1·5		1·7
2				17·4		7·9		2·1		1·5		1·9
3				17·4		6·9		2·1		1·5	0·9	2·1
4				17·4	1·1	5·9	0·9	2·1	0·85	1·5		2·1
5				17·4		5·2		2·3		1·5		2·1
6				17·4		4·5		2·5		1·5		2·1
7				17·4	1·0	3·8		2·7		1·5	0·9	2·1
8				17·4		3·8	0·95	3·0		1·5		2·0
9				17·4		3·8		2·5	0·85	1·5		1·8
10			1·5	17·4	1·0	3·8	0·9	2·1		1·3		1·6
11			1·5	17·4		3·8		2·1		1·2	0·85	1·5
12				16·3		3·8		2·1		1·1		
13				15·1		3·8		2·1		0·9		
14				14·0		3·8		2·1	0·8	0·8		
15			1·35	12·8	1·0	3·8	0·9	2·1		1·1		
16				13·3		3·4		2·0	0·85	1·5		
17				13·8		3·0		1·8		1·6		
18			1·4	14·3		2·6		1·6		1·7		
19				14·3	0·9	2·1	0·85	1·5		1·8		
20			1·4	14·3		2·1		1·6		1·9		
21				13·5		2·1		1·7		2·0		
22				12·8	0·9	2·1		1·8	0·9	2·1		
23				12·0		1·9		1·9		1·4		
24			1·3	11·3		1·8		2·0	0·8	0·8		
25				11·0		1·7	0·9	2·1		1·0		
26				10·6	0·85	1·5		2·1		1·2		
27				10·2		1·8	0·9	2·1		1·4		
28	1·2	8·4	1·25	9·9	0·9	2·1		1·8	0·85	1·5		
29		11·4		9·9		2·1	0·85	1·5		1·5		
30		14·4		9·9		2·1		1·5		1·5		
31			1·25	9·9				1·5	0·85	1·5		

MONTHLY DISCHARGE of Dairy Creek, six miles south of Kamloops Lake, for 1912.

(Drainage area, 13 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches
May	17·4	9·9	14·2	1·1	1·27	873	
June	8·9	1·5	3·5	0·27	0·30	208	
July	3·0	1·5	2·0	0·15	0·17	123	
August	2·1	0·8	1·4	0·11	0·13	86	
The period							10

NOTE.—Accuracy, "C."

Deadman River.

Deadman river has its source in the plateau south of Bonaparte lake, at an elevation of 4,000 feet. It discharges into Thompson river near Savona, at an elevation of 1,100 feet. Criss creek enters from the east, and Barricade, Gorge and Tobacco creeks from the west. The drainage area is 480 square miles above the mouth, 450 square miles above the gauge, and 330 square miles above Criss creek.

Deadman river is in the Dry Belt. The mean annual rainfall is about 10 inches. The summers are hot and dry, the winters cold and dry.

The water of the Deadman is used for irrigation. Some of it is used on two ranches 10 miles or more from the mouth; the Indians use some on their reserve; but three irrigation companies, Smith-Curtis, Savona Orchards Company, and the Barnes Estate, take most of it.

The Smith-Curtis intake on Deadman river is about 3 miles from the mouth. A timber-cribbed dam, 30 feet long and 7 feet high, has been constructed across the stream. The intake is on the east side of the dam, and the flume follows down the east side of the river for 100 yards, then crosses by a substantial bridge. About 400 yards further on, a canyon is reached, which is traversed by a wooden trestle 40 feet high.

The capacity of the Smith-Curtis main canal is about 11 cubic feet per second. It is 2·5 feet wide and 20 inches high. It is a timber flume, caulked and tarred. By this irrigation system part of the Deadman Indian Reserve, part of section 5, township 21-21-6, part of section 32 township 20-21-6, and part of the old townsite of Savona Ferry are irrigated by Smith-Curtis.

The main canal of the Barnes Estates is 10 miles long from the intake to the easterly boundary of the estate. In this there are 7½ miles of flume and 2½ miles of ditch. The main flume is 6 feet wide and 4 feet deep and will carry 3 feet of water. It is made of 1¾-inch boards, well seasoned; the sides and bottom are shiplapped, and the seams are caulked with oakum, and the whole interior coated with tar, making a very permanent and water-tight construction.

The slope of the main flume is 5 feet to the mile, the velocity is 3·8 feet per second, and the capacity is 70 c.f.s.

The main ditch is slightly larger than the flume; the gravelly subsoil is porous, and to prevent losses, is puddled with silt and a little concrete.

The distribution system is rather elaborate, and is not described here.

In order to conduct water from the main Barnes canal across Thompson river to the British Columbia Horticultural Estates at Walhachin, a 12-inch wooden stave syphon has been suspended by cable across the river. The water drops 500 feet from the main canal, crosses the river through the suspended pipe and rises 400 feet on the south side. Five cubic feet per second are thus brought across the river to irrigate about 500 acres of orchard.

The Savona Orchards Company obtains its water from the Barnes canal by arrangement with the Barnes Estates.

Just outside the northerly limit of the Railway Belt, Deadman river widens into a lake, called Deadman or Snohoosh lake. This lake is a narrow winding body of water about three miles long, with a superficial area of 3,500 acres. It affords a good reservoir site. The Barnes Estates have constructed a dam at the outlet of the lake to conserve the waters of the spring freshet until they are needed for irrigation in July and August. The dam is timber-cribbed and rock-filled, the timbers being lock-bolted together; it is founded on bed rock, and the base is concrete-lined, with two 24-inch steel pipes laid in concrete. The flow through the dam is controlled by gates in these pipes. The dam is 140 feet long, and 20 feet high, with a width at the base of 56 feet. The capacity of the reservoir is 7,000 acre-feet.

By the time the freshet on Criss creek is over, Deadman lake reservoir is full and the surplus water usually provides the irrigation supply for a week or so without opening the gates of the dam. So the company is able to start the dry part of the irrigation season with a full reservoir. There are other lakes which could be used for storage if necessary, and it seems probable that there will always be sufficient water for all the land that can be irrigated from Deadman river.

The Deadman country is rough and broken but not really mountainous. The numerous roads and trails which traverse it are evidence of this. The head-waters of the stream are in the southern part of Bonaparte plateau. The elevation at the mouth of the Deadman is 1,100 feet; at Criss creek, 10 miles from the mouth, 1,500 feet; at Deadman lake, 20 miles from the mouth, 2,750 feet. Several of the lakes at the head-waters are at about 4,500 feet.

The main gauging station (221) on Deadman river is at the Williams ranch, below the mouth of Criss creek and above the Walhachin intake. It thus measures practically the whole flow of the stream. It was established on July 11, 1911, and gauge readings were taken daily during the irrigation season of 1911 and 1912. There is a staff gauge nailed to a tree on the right bank of the river and it is referred to three bench-marks. During very high water it is hard to read the gauge closely on account of the unsteadiness of the water. The measurements were made by wading at a point 150 feet below the gauge, as the water is deeper there and not so swift. There is a straight stretch of 150 feet, above the measuring section, mostly riffles. There is a deep hole below the section. The right bank is a gravel bar rising to a height of five feet, some distance from the water. The left bank is five feet high, and covered with bushes. There is only one channel at the gauge, but it is claimed that there is considerable underground flow.

A station (223) was established about 4 miles below the main station to give the unused water, and by subtraction, the amount of water in the Walhachin flume. The station showed that there was always plenty of water, on account of the underground flow past the intake, and was of no other use. So readings were discontinued there and a gauge put in the flume (222) instead. Readings were taken on the flume gauge during the irrigation season of 1912.

DISCHARGE MEASUREMENTS of Deadman River, above Walhachin Intake, for 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
1911.							
July 11	C. G. Cline	1046	32	48	2·0	2·06	98
Sept. 23	K. Smith	1046	21	21	0·75	1·26	15·8
1912.							
May 4	C. G. Cline	1046	40	71	2·8	2·75	203
June 16	Cline and Corbould	1046	30	43	3·1	2·45	132
July 16	B. Corbould	1044	26	34	1·4	1·9	48
Aug. 5	"	1044	26	25·4	1·7	1·83	44
Aug. 30	"	1044	25	28·4	1·4	1·81	42

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DAILY GAUGE HEIGHT AND DISCHARGE of Deadman River, above Walhachin Intake, for 1911.

Day.	July.		August.		September.	
	Guage height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·65	33	1·1	11
2			1·65	33	1·1	11
3			1·65	33	1·1	11
4			1·65	33	1·1	11
5			1·65	33	1·15	12
6			1·75	39		
7			1·75	39		
8			1·7	36		
9			1·7	36		
10			1·7	36		
11	2·1	67	1·7	36		
12	1·9	49	1·65	33		
13	1·7	36	1·65	33		
14	1·6	31	1·6	31		
15	1·5	26	1·6	31		
16	1·4	22	1·55	28		
17	1·4	22	1·5	26		
18	1·35	20	1·45	24		
19	1·3	18	1·4	22		
20	1·2	14	1·4	22		
21	1·2	14	1·3	18		
22	1·2	14	1·3	18		
23	1·2	14	1·25	16		
24	1·4	22	1·2	14		
25	1·5	26	1·2	14		
26	1·55	28	1·2	14		
27	1·6	31	1·2	14		
28	1·6	31	1·1	11		
29	1·6	31	1·1	11		
30	1·65	33	1·15	12		
31	1·65	33	1·15	12		

MONTHLY DISCHARGE of Deadman River, above Walhachin Intake, for 1911.

(Drainage area, 450 square miles.)

Month.	Discharge in Second Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
July	67	14	27·7	0·06	0·07	1,703	
August	39	11	25·5	0·06	0·07	1,570	
The period							10

NOTE.—The station was abandoned for the season of 1911 at the close of the irrigation season. Winter conditions exist during December, January and February.

Accuracy, "D" in July; "A" in August.

DAILY GAUGE HEIGHT AND DISCHARGE of Deadman River, above Walhachin Intake, for 1912.

Day.	MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Guage height.	Discharge	Guage height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			2·9	238	2·2	80	2·1	67	1·85	45
2			2·9	238	2·3	98	2·2	80	.....	70
3			2·85	226	2·3	98	2·0	57	.....	95
4			2·7	190	2·3	98	1·85	45	2·4	120
5	2·75	201	2·6	166	2·2	80	1·85	45	.....	100
6	2·9	238	2·55	154	2·2	80	1·8	42	2·2	80
7	3·3	329	2·5	143	2·3	98	1·8	42	.....	74
8	4·0	492	2·45	132	2·2	80	1·8	42	2·1	67
9	4·4	584	2·4	120	2·15	74	1·8	42	. .	. .
10	4·3	561	2·5	143	2·1	67	1·85	45	.	.
11	4·4	584	2·3	98	2·0	57	.....	45	.	.
12	4·5	608	2·3	98	2·0	57	1·85	45	.	.
13	4·6	631	.....	94	2·1	67	1·9	49	.	.
14	4·5	608	.....	90	2·1	67	. . .	49	.	.
15	4·3	561	.....	85	2·0	57	1·9	49	.	.
16	4·3	561	2·2	80	1·9	49	1·95	53	.	.
17	4·0	492	2·15	74	1·8	42	1·95	53	.	.
18	3·8	445	2·1	67	1·75	39	1·9	49	.	.
19	3·75	434	2·05	62	1·7	36	1·9	49	.	.
20	3·7	422	2·05	62	1·65	34	. . .	48	.	.
21	4·0	492	2·05	62	1·7	36	.....	46	.	.
22	4·1	515	2·0	57	1·75	39	1·85	45	.	.
23	4·0	492	2·0	57	2·5	143	1·75	39	.	.
24	3·9	468	2·0	57	3·5	376	.....	37	.	.
25	3·8	445	2·0	57	3·2	306	1·7	36	.	.
26	3·7	422	2·0	57	2·9	238	.....	36	.	.
27	3·55	387	2·0	57	2·7	190	1·7	36	.	.
28	3·3	329	2·1	67	2·4	120	1·7	36	.	.
29	3·15	294	2·15	74	2·25	89	. . .	39	.	.
30	3·0	260	2·2	80	2·15	74	1·8	42	.	.
31	2·9	238	.....	. .	2·1	67	1·85	45	.	.

MONTHLY DISCHARGE of Deadman River, above Walhachin Intake, for 1912.

(Drainage area, 450 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches
May	631	201	448	1·0	1·2	27,550	
June	238	57	106	0·24	0·27	6,310	
July	376	34	98	0·22	0·25	6,030	
August	80	36	46	0·1	0·11	2,830	
The period							11

NOTE.—Station maintained during irrigation season only. Winter conditions exist during December, January and February.

Accuracy "A" and "C."

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DISCHARGE MEASUREMENTS of Deadman River, Three Miles From Mouth, 1911.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
July 12	C. G. Cline	1046	36	60	1·1	1·22	66
Sept. 23	Cline & Smith	1046	23	31	0·7	0·71	23
Oct. 4	" "	1046	23	26	0·6	0·57	15·3

DAILY GAUGE HEIGHT AND DISCHARGE of Deadman River, Three Miles from Mouth, for 1911.

Day.	July.		August.		September.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·85	32	0·45	13
2			0·85	32	0·45	13
3			0·85	32	0·45	13
4			0·85	32	0·45	13
5			0·85	32	0·5	17
6			0·9	36		
7			0·9	36		
8			0·9	36		
9			0·9	36		
10			0·9	36		
11			0·9	36		
12	1·1	54	0·85	32		
13	1·0	45	0·8	28		
14	0·85	32	0·8	28		
15	0·75	25	0·8	28		
16	0·7	22	0·7	22		
17	0·65	20	0·6	17		
18	0·6	17	0·55	16		
19	0·5	14	0·55	16		
20	0·5	14	0·55	16		
21	0·5	14	0·5	14		
22	0·5	14	0·5	14		
23	0·5	14	0·5	14		
24	0·55	16	0·5	14		
25	0·55	16	0·5	14		
26	0·55	16	0·5	14		
27	0·6	17	0·5	14		
28	0·6	17	0·5	14		
29	0·7	22	0·5	14		
30	0·75	25	0·45	13		
31	0·8	28	0·45	13		

MONTHLY DISCHARGE of Deadman River, Three Miles From Mouth, for 1911.

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.†
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
July	54	14	22·1			1,360	
August	36	13	23·6			1,450	
The period							10

NOTE.—Station established July 12, and continued until September 5, 1911. The station is below the Walhachin Intake. The drainage area is therefore not a function of the run-off.
Accuracy, "A."

DISCHARGE MEASUREMENTS of Deadman River, in Walhachin Flume, 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
July 13	B. Corbould	1044	6·2	6·8	2·4	1·1	16·6
Aug. 6	"	1044	5·8	6·9	3·2	1·3	22·4
Aug. 31	"	1044	5·8	3·4	2·3	0·62	7·9

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DAILY GAUGE HEIGHT AND DISCHARGE of Deadman River in Walhachin Flume. Two Miles from Intake, for 1912.

DAY.	JULY.		AUGUST.	
	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·4	25·4
2			1·4	25·4
3			1·4	25·4
4			1·35	23·9
5			1·3	22·4
6			1·3	22·4
7			1·3	22·4
8			1·3	22·4
9			1·3	22·4
10			1·3	22·4
11			1·3	22·4
12			1·3	22·4
13			1·3	22·4
14			1·3	22·4
15	1·1	16·6	1·3	22·4
16	1·1	16·6	1·3	22·4
17	1·2	19·4	1·3	22·4
18	1·1	16·6	1·3	22·4
19	1·1	16·6	1·3	22·4
20	1·3	22·4	1·3	22·4
21	1·3	22·4	1·2	19·4
22	1·4	25·4	1·2	19·4
23	1·3	22·4	1·2	19·4
24	1·2	19·4	1·1	16·6
25	1·2	19·4	1·1	16·6
26	1·3	22·4	0·0	0·0
27	1·4	25·4	0·0	0·0
28	1·4	25·4	0·0	0·0
29	1·4	25·4		
30	1·4	25·4		
31	1·4	25·4	0·62	7·9

DUFFY CREEK (228.)

Duffy creek has its source in the range hills south of Kamloops lake, at an elevation of 4,000 feet, and discharges into Kamloops lake just west of Cherry at an elevation of 1,120 feet. It is part of the Thompson drainage; its drainage area, as measured from the Geological Survey map, dated 1895, scale 2 miles to an inch, is 17 square miles: of this, 10 square miles is above the station. Duffy creek is a small irrigation stream of little importance; situated in the heart of the Dry Belt, the creek only runs in the spring. The summers are hot and dry; the winters long and cold; the precipitation is about 10 inches. There are good storage possibilities on the lakes at the head-waters of the creek; but the drainage area is so small that there is a very small run-off, so much so that during 1912, an exceptionally wet season, the maximum flow was only a fraction of a second-foot; the lakes did not fill up to the outlet. This was probably due to the very dry years previous to 1912, when the lakes dried up completely.

During the freshet of 1912, the Beaton storage reservoir, where water from Dairy creek is stored, collapsed. The water swept down the Duffy creek channel to Kamloops lake, carrying away a large section of the C.P.R. road-bed.

A river station was established on Duffy creek, April 26, 1912, by H. J. Keys, above all diversions. A standard vertical staff gauge is located about 50 feet above the highest diversion, its datum being referred to two bench-marks. Only one measurement was made, giving a discharge of one-tenth of a second-foot. The creek has good banks and one channel, with a permanent bed; but the stream is badly choked with logs.

Eagle River (312.)

Eagle river is a stream 40 miles long, rising in Victor and Summit lakes (township 23-3-6)) at Clanwilliam, at an elevation of about 2,200 feet flowing west into Shuswap lake, near Sicamous, B.C., at an elevation of 1,150 feet. Near the mouth the river is sluggish, about 150 feet wide and from 5 feet to 15 feet deep. Above Yard creek (10 miles from the mouth) the river becomes swift and falls about 1,000 feet in the 30 miles from Eagle pass.

The precipitation varies from 20 inches at the mouth to 100 inches at the source. The winter conditions are not severe, but the snowfall is very great near the source (120 inches). The river freezes from two to three months during the winter.

At Taft and Three Valley the Dominion Sawmills, Ltd., have mills, and logs are driven down the river from the various limits.

On the river itself there are no power developments, but the Dominion Sawmills at Taft utilize Crazy creek to develop power for lighting purposes. There are possibilities for small power on the stream, for which storage could be obtained in Three Valley lake and at the source in Victor and Clanwilliam lakes. To the latter the drainage area is very small. The C.P.R. running along the river prevents any large development.

A regular gauging station was established on Eagle river at the C.P.R. bridge, three-quarters of a mile from Sicamous. The gauge is a vertical staff 15 feet long fastened to the piling beneath the bridge. Measurements are made from the bridge. During extreme high water on Shuswap lake there is a tendency toward back-water at the gauge.

Discharge Measurements of Eagle River, near Sicamous, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
1911.							
Aug. 23..	C. E. Richardson.	1048	130	600	1·8	4·42	1,075
Oct. 10..	" "	1048	133	450	1·4	3·15	618
1912.							
Feb. 29..	C. E. Richardson.....	1047	118	341	0·7	2·07	253
May 21..	H. C. Hughes.....	1055	212	1,746	3·1	10·01	5,340
June 17..	C. E. Richardson.....	1048	200	1,700	3·1	10·06	5,200
July 12..	" "	1048	202	1,050	2·0	6·95	2,100
Sept. 7..	" "	1049	136	675	2·0	4·5	1,362
Oct. 5...	" "	1055	133	497	1·7	3·55	870

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DAILY GAUGE HEIGHT AND DISCHARGE of Eagle River, near Sicamous, for 1911.

Day.	August.		September.		October.		November.		December.	
	Gauge height.	Discharge	Gauge height	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1				1,052		818		452		632
2			4·2	1,052	3·4	764		446	3·0	620
3				1,066		737	2·5	440		620
4			4·27	1,080		710		458	3·0	620
5				1,022		683	2·6	476		620
6				965	3·1	656	2·55	458		620
7			3·8	908		638		452	3·0	620
8				857	3·0	620		446		656
9			3·52	807		647	2·5	440	3·2	692
10				803	3·15	674		440		680
11			3·5	800		647	2·5	440		668
12				958	3·0	620		476	3·1	656
13				1,116		674	2·7	512		656
14			4·8	1,274		728		572	3·1	656
15				1,212	3·45	782		632		656
16				1,150		737	3·2	692	3·1	656
17			4·3	1,088	3·2	692		674		620
18				1,007		656	3·1	656	2·9	584
19			3·85	926	3·0	620		656		530
20				908		608		656	2·6	476
21			3·75	890		596		656		488
22				880	2·9	584	3·1	656		500
23	4·4	1,124		870		572		656	2·7	512
24			3·67	861		560		656		500
25	4·2	1,052		813	2·8	548	3·1	656		488
26			3·4	764		530		656	2·6	476
27	4·1	1,016		746	2·7	512	3·1	656		476
28			3·3	728		494		656	2·6	476
29	4·0	980		800	2·6	476	3·1	656		464
30			5·7	872		467		644		452
31	4·2	1,052			2·55	458			2·5	440

MONTHLY DISCHARGE of Eagle River, near Sicamous, for 1911.
(Drainage area, 460 square miles.)

Month.	Discharge in Second-Feet.			Run-Off.			Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
September	1,274	728	942	2·05	2·29	56,000	
October	818	458	629	1·37	1·58	38,700	
November	692	440	567	1·23	1·37	33,700	
December	692	440	575	1·25	1·44	35,400	
The period							60

NOTE.—During the month of December partial ice conditions prevailed. Since the discharges given are derived from a curve applicable only to conditions of open flow, the figures given for this month are probably slightly in excess of their true values.

Accuracy, "A," except in December, when it was "C."

DAILY GAUGE HEIGHT AND DISCHARGE of

Day.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft
1	.....	450	.....	572	2·3	368	.....	476	.....	1,590	.....	4,093
2	.....	460	2·8	548	.....	363	2·7	512	.....	1,603	.....	3,957
3	2·6	476	.....	535	.....	358	.....	584	5·7	1,616	.....	3,821
4	.....	485	.....	522	.....	354	.....	656	.....	1,654	8·8	3,685
5	2·65	494	.....	508	2·25	350	3·3	728	.....	1,692	.....	3,668
6	.....	512	2·65	494	.....	326	.....	728	6·0	1,730	.....	3,652
7	2·75	530	.....	536	.....	302	.....	728	.....	2,030	8·75	3,636
8	.....	521	.....	578	2·05	278	.....	728	.....	2,331	.....	3,847
9	2·7	512	3·0	620	.....	272	3·3	728	.....	2,631	.....	4,058
10	.....	512	.....	620	.....	268	.....	299	7·95	2,932	.....	4,269
11	.....	512	.....	620	.....	264	.....	1,130	.....	3,120	9·5	4,480
12	2·7	512	.....	620	2·0	260	4·95	1,331	.....	3,308	.....	5,020
13	.....	534	3·0	620	.....	260	.....	1,374	.....	3,496	.....	5,560
14	.....	556	.....	626	.....	272	.....	1,417	8·8	3,685	10·5	6,100
15	.....	579	.....	632	2·05	278	.....	1,460	.....	4,165	.....	5,863
16	2·95	602	3·05	638	.....	270	5·4	1,502	.....	4,645	.....	5,573
17	.....	596	.....	638	.....	261	.....	1,495	9·95	5,123	10·07	5,310
18	.....	590	.....	638	.....	252	.....	1,489	.....	5,142	.....	5,805
19	2·9	584	.....	638	1·95	243	5·35	1,483	.....	5,161	10·6	6,300
20	.....	554	5·05	638	.....	239	.....	1,487	.....	5,180	.....	6,267
21	.....	522	.....	608	.....	236	.....	1,492	10·0	5,200	.....	6,233
22	.....	490	.....	578	1·92	233	.....	1,495	.....	5,099	10·55	6,200
23	2·55	458	2·8	548	.....	240	5·4	1,502	.....	4,998	.....	5,765
24	.....	505	.....	507	.....	247	.....	1,502	9·8	4,897	.....	5,331
25	.....	549	.....	466	.....	254	.....	1,502	.....	5,055	9·8	4,897
26	2·95	602	.....	426	2·0	260	5·4	1,502	.....	5,213	.....	4,778
27	.....	606	2·35	386	.....	296	.....	1,521	.....	5,371	.....	4,663
28	.....	610	.....	332	.....	332	.....	1,540	10·2	5,530	9·55	4,547
29	.....	615	2·05	278	2·3	368	.....	1,559	.....	5,097	.....	4,237
30	3·0	620	..	.	.	404	5·6	1,578	.....	4,663	.....	3,928
31	.....	596				440			9·3	4,229		

SESSIONAL PAPER No. 25f

Eagle River, near Sicamous, for 1912.

Day.	July.		August.		September.		October.		November.		December.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		3,619		1,635		1,225	3·25	710	3·35	746		692
2	8·4	3,310	5·7	1,616		1,268		806		732		683
3		3,252		1,597	4·9	1,312		902		719	3·15	674
4		3,194		1,578		1,262	4·05	998		705		656
5	8·2	3,136		1,559		1,211		962	3·20	692		638
6		3,037	5·5	1,540	4·5	1,160		926		686	3·0	620
7		2,938		1,527		1,217		890		680		606
8		2,840		1,515		1,274	3·65	854	3·15	674		592
9	7·7	2,742	5·4	1,502		1,331		830		678		578
10		2,550		1,492	5·1	1,388		806		682	2·85	566
11		2,440		1,483		1,376	3·45	782		687		560
12	7·1	2,292		1,473		1,333		773	3·20	692		554
13		2,266	5·3	1,464	5·0	1,350		764		704	2·8	548
14		2,240		1,496		1,280		755		716		539
15		2,214		1,528		1,210	3·35	746	3·30	728		530
16	6·95	2,188	5·55	1,559		1,140		916		719		521
17		2,101		1,506	4·25	1,070		1,086		710	2·7	512
18		2,015		1,454		1,043	4·75	1,255		701		512
19	6·45	1,928		1,402		1,016		1,100	3·20	692		512
20		1,911	5·0	1,350		989		946		746	2·7	512
21		1,894		1,382		962		792		800		507
22		1,878		1,414		935	3·05	638	3·65	854		502
23	6·3	1,862	5·25	1,445		908		716		840		498
24		1,869		1,416		881		794		827	2·65	494
25		1,876		1,387		854	3·70	872		813		488
26	6·35	1,884		1,359		827		863	3·50	800		482
27		1,831	4·95	1,331	3·5	800		854		770	2·6	476
28		1,779		1,268		777		845		740		471
29		1,726		1,205		755	3·60	836	3·25	710		466
30	5·85	1,673	4·45	1,142		732		816		701		462
31		1,654		1,182				795			2·55	458

MONTHLY DISCHARGE of Eagle River, near Sicamous, for 1912.

(Drainage area, 460 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
January	620	450	540	1·17	1·35	33,200	
February	638	278	551	1·20	1·29	31,700	
March	440	233	295	·64	·74	18,100	
April	1,578	476	1,205	2·62	2·92	71,700	
May	5,530	1,590	3,812	8·29	9·56	234,300	
June	6,300	3,636	4,851	10·54	11·75	288,600	
July	3,619	1,654	2,328	5·06	5·83	143,200	
August	1,655	1,142	1,445	3·14	3·62	88,800	
September	1,388	732	1,097	2·38	2·65	65,000	
October	1,255	638	859	1·87	2·16	52,800	
November	854	674	731	1·59	1·77	43,500	
December	692	458	545	1·18	1·36	33,500	
The period	6,300	233	1,522	3·31	45·00	1,104,400	60 to 70

NOTE.—During the months of January and February partial ice conditions prevailed. Since the discharges given are derived from a curve applicable given for these two months are probably slightly in excess of their true values.

Accuracy: January, February and December, "C"; July, "B"; the remaining months, "A."

EDWARDS CREEK (241.)

Edwards creek has its source in lakes near the head-waters of Sullivan creek, at a probable elevation of 2,800 feet, and discharges into Hefferly creek, 5 miles from the mouth, at an elevation of 2,000 feet. It is part of the Hefferly-Thompson drainage; the drainage area, as measured from the Geological Survey map, dated 1895, scale 2 miles to an inch, is 20 square miles; of this area 15 square miles is above the station. In the upper reaches of the creek the annual precipitation may sometimes be as high as 25 inches; at its mouth the mean annual precipitation is probably from 10 to 12 inches.

Edwards creek, locally known as the north fork of Hefferly creek, is a small irrigation stream about 8 miles long. It drains a country typical of the Hefferly and Louis creek section. There is some large timber on the hills, and practically the whole drainage area is well covered with British Columbia fir, bull pine, jack pine, etc. There is, however, some open country in the valley proper, which affords excellent ranch land, though there is a danger of summer frosts in the upper portions of the creek, owing to the altitude. The creek is about 10 feet wide; during the freshet it has a depth of from 12 to 18 inches, but in the late fall it is practically dry. Two branches join shortly below their sources; good opportunity for storage is offered by two lakes, and this is utilized to a small extent by the local settlers, who have repaired the beaver dams for their own use. There is a small alienating ditch about a mile above the Hydrographic Survey station, which diverts a maximum of one second-foot to the Sullivan valley.

The river station on Edwards creek was established June 24, 1911, by C. G. Cline. The measuring section is located half a mile below the diversion dam, and 10 feet above the foot bridge opposite the Devick house. A standard vertical staff gauge is

located at the measuring section and referred to two bench-marks. This is an excellent section; there is a good control, high banks, uniform current, and one permanent channel.

DISCHARGE MEASUREMENTS of Edwards Creek, three miles from mouth, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
1911.							
June 24	C. G. Cline	1046	5·0	1·5	0·7	0·64	1·16
Aug. 14	"	1046	3·5	1·5	0·4	0·58	0·6
1912.							
May 2	Cline and Dann	1046	9·0	9·4	2·1	1·45	19·7
May 14	E. M. Dann	1044	10	17·2	2·0	2·10	34·5
May 29	"	1044	8·5	7·3	1·85	1·50	13·5
Aug. 20	H. J. F. Keyes	1057	7·5	3·8	1·1	1·01	*4·2

* Different section.

DAILY GAUGE HEIGHT AND DISCHARGE of Edwards Creek, three miles from mouth, for 1911.

Day.	June.		July.		August.		September.		October.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1.			0·65	1·0		0·8	0·55	0·7	0·5	0·6
2.				0·9		0·8	0·55	0·7	0·5	0·6
3.			0·6	0·8		0·8	0·55	0·7	0·5	0·6
4.			0·6	0·8		0·8	0·55	0·7	0·5	0·6
5.			0·6	0·8		0·8	0·55	0·7	0·5	0·6
6.			0·6	0·8		0·8	0·55	0·6	0·5	0·6
7.			0·6	0·8		0·8	0·5	0·6	0·5	0·6
8.			0·6	0·8	0·6	0·8	0·5	0·6	0·5	0·6
9.			0·6	0·8	0·6	0·8	0·5	0·6	0·5	0·6
10.			0·7	1·3	0·6	0·8	0·5	0·6	0·5	0·6
11.			0·7	1·3	0·6	0·8	0·5	0·6	0·5	0·6
12.			0·7	1·3	0·6	0·8	0·5	0·6	0·5	0·6
13.			0·7	1·3	0·6	0·8	0·5	0·6	0·5	0·6
14.			0·7	1·3	0·6	0·8	0·5	0·6	0·5	0·6
15.			0·7	1·3	0·6	0·8	0·5	0·6	0·5	0·6
16.				1·2	0·6	0·8	0·5	0·6	0·5	0·6
17.			0·65	1·0	0·6	0·8	0·5	0·6	0·5	0·6
18.			0·65	1·0	0·6	0·8	0·5	0·6	0·5	0·6
19.			0·65	1·0	0·6	0·8	0·5	0·6	0·5	0·6
20.			0·65	1·0	0·6	0·8	0·5	0·6	0·5	0·6
21.			0·65	1·0	0·6	0·8	0·5	0·6	0·5	0·6
22.			0·7	1·3	0·6	0·8	0·5	0·6	0·5	0·6
23.			0·55	1·0	0·6	0·8	0·5	0·6	0·5	0·6
24.	0·65	1·0	0·65	1·0	0·6	0·8	0·5	0·6	0·5	0·6
25.	0·65	1·0		1·0	0·55	0·7	0·5	0·6	0·5	0·6
26.	0·55	1·0		1·0	0·55	0·7	0·5	0·6	0·5	0·6
27.	0·65	1·0		0·9	0·55	0·7	0·5	0·6	0·5	0·6
28.	0·6	0·8		0·9	0·55	0·7	0·5	0·6	0·5	0·6
29.	0·6	0·8		0·8	0·55	0·7	0·5	0·6	0·5	0·6
30.	0·6	0·8	0·6	0·8	0·55	0·7	0·5	0·6	0·5	0·6
31.				0·8	0·55	0·7			0·5	0·6

MONTHLY DISCHARGE of Edwards Creek, three miles from mouth, for 1911.

(Drainage area, 15 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
July	1·3	0·8	1·0	·07	·08	61·	
August	0·8	0·7	0·8	·05	·06	49·	
September	0·7	0·6	0·6	·04	·04	36·	
October	0·6	0·6	0·6	·04	·04	37·	
The period							12

NOTE.—Winter conditions exist from December 1 to April 1, during which time the run-off is very small.

Accuracy, "A."

DAILY GAUGE HEIGHT AND DISCHARGE of Edwards Creek, three miles from mouth, for 1912.

Day.	April.		May.		June.		July.		August.		September.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·92	3·0	1·35	10·0	0·9	2·8	1·0	4·0	1·0	4·0
2			1·35	10·0	1·3	9·0	0·95	3·4	1·0	4·0	1·0	4·0
3			1·4	11·0	1·25	8·0	1·00	4·0	1·0	4·0	1·0	4·0
4			1·4	11·0	1·25	8·0	1·05	4·7	1·0	4·0	1·0	4·0
5			1·42	11·5	1·2	7·0	1·15	6·2	1·0	4·0	1·0	4·0
6			1·52	14·1	1·2	7·0	1·15	6·2	1·0	4·0	1·0	4·0
7			1·67	18·5	1·2	7·0	1·15	6·2	1·0	4·0	1·0	4·0
8			2·05	32·5	1·15	6·2	1·1	5·5	1·0	4·0	1·05	4·7
9			2·3	44·0	1·1	5·5	1·1	5·5	1·0	4·0	1·1	5·5
10			2·17	37·8	1·1	5·5	1·1	5·5	1·0	4·0	1·1	5·5
11			2·05	32·5	1·1	5·5	1·15	5·5	1·0	4·0	1·1	5·5
12			2·07	33·5	1·1	5·5	1·05	4·7	1·0	4·0	1·05	4·7
13			2·1	35·	1·1	5·5	1·05	4·7	1·0	4·0	1·05	4·7
14			2·1	35·	1·1	5·5	1·05	4·7	1·0	4·0	1·0	4·0
15			2·1	35·	1·15	6·2	1·05	4·7	1·0	4·0	1·0	4·0
16			2·1	35·	1·15	6·2	1·0	4·0	1·0	4·0	1·0	4·0
17			2·05	32·5	1·15	6·2	1·0	4·0	1·0	4·0	1·0	4·0
18			2·0	30·	1·1	5·5	1·0	4·0	1·0	4·0	1·0	4·0
19			1·9	26·	1·0	4·0	1·0	4·0	1·0	4·0	1·0	4·0
20			1·85	24·5	1·0	4·0	0·95	3·4	1·0	4·0	1·0	4·0
21	0·4	0·5	1·8	23·0	0·95	3·4	0·95	3·4	1·0	4·0	1·0	4·0
22	0·4	0·5	1·85	24·5	0·95	3·4	1·05	4·7	1·0	4·0		
23	0·45	0·5	1·85	24·5	0·9	2·8	1·15	6·2	1·0	4·0		
24	0·45	0·5	1·85	24·5	0·9	2·8	1·15	6·2	1·0	4·0		
25	0·5	0·6	1·8	23·0	0·85	2·4	1·20	7·0	0·95	3·4		
26	0·55	0·7	1·7	19·4	0·85	2·4	1·20	7·0	0·95	3·4		
27	0·55	0·7	1·6	16·4	0·85	2·4	1·15	6·2	0·95	3·4		
28	0·55	0·7	1·55	15·0	0·9	2·8	1·1	5·5	0·95	3·4		
29	0·65	1·0	1·5	13·5	0·9	2·8	1·05	4·7	0·95	3·4		
30	0·85	2·4	1·4	11·0	0·9	2·8	1·05	4·7	0·95	3·4		
31			1·4	11·0			1·05	4·7	0·95	3·4		

MONTHLY DISCHARGE of Edwards Creek, three miles from mouth, for 1912.

(Drainage area, 15 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	44·0	3·0	23·1	1·54	1·77	1,420	
June	10·0	2·4	5·2	·35	·39	309	
July	7·0	2·8	5·0	·33	·38	307	
August	4·0	3·4	4·0	·27	·31	246	
September	5·5	4·0	4·0	·27	·30	238	
The period							15

NOTE.—May and June, Accuracy "B"; July, August and September, Accuracy "A."

EMERALD RIVER (4144).

Emerald river is 5 miles long and rises in Emerald lake at an elevation of 4,400 feet and is a tributary of Kicking Horse river, which it joins near Field, at an elevation of 3,800 feet. It is 15 feet to 25 feet wide and from 1 foot to 3 feet deep. The valley is sloping and heavily timbered. There are no rainfall data available, but the precipitation is probably about 50 inches, of which half is in the form of snowfall. The drainage area is about 21 square miles.

There are no interests on the river. The outstanding feature of this drainage is Emerald lake, which covers an area of about 400 acres and is surrounded by a chain of mountain peaks, Wapta, Field, Burgess, Emerald and Carnarvon. The stream is entirely glacial fed, and the water is a most gorgeous green.

The drainage area is wholly within the Yoho National Park and a beautiful road known as 'Snow Peak Avenue' has been built from Field to the lake. Thousands of tourists annually take this drive and stop at the C.P.R. chalet situated at the foot of the lake facing the Wapta glacier and ice fields.

A gauging station was established on June 5, 1912, by C. E. Richardson, and miscellaneous measurements of the flow made during the season, but no regular gauge readings were taken. The gauge is a standard vertical staff 5½ feet long and is fastened to the left abutment on the downstream side of the bridge, from the upstream side of which measurements are made at high water. In low water, measurements are made by wading. The stream is confined to one channel, and at the measuring section the total now passes between the bridge abutments. Three bench-marks were located and referred to the gauge datum.

DISCHARGE MEASUREMENTS of Emerald River, near Field, B.C., 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
June 5	C. E. Richardson	1048	22	24	2·1	2·01	49·6
June 26	"	1048	36	62	3·93	2·92	*237·
July 1	"	1048	36	44·6	3·24	2·50	144·
Aug. 5	"	1048	36	46·4	3·37	2·58	156·
Aug. 14	"	1048	36	32·	3·3	2·31	106·
Oct. 2	"	1048	18	19·	1·65	1·85	31·3

Estimated minimum discharge during the winter, 5 second-feet.
*Approximate maximum.

ESSELL CREEK (307).

Essell creek, locally known as Summit Lake creek, has its source in Summit lake near the divide between Monte creek and Grand Prairie, at an elevation of 2,050 feet, and discharges into Salmon river near Grand Prairie at an elevation of 1,800 feet. Its drainage area is a little over 6 square miles, and its natural run-off is very small. A diversion has, however, been made from Monte creek to Summit lake by a ditch about a mile long, and it is this Monte creek water which provides the greater part of the flow of Essell creek. This water is used for irrigation around Grand Prairie, where there are over 5,000 acres of land under cultivation. The precipitation in the Essell creek drainage area is from 12 inches to 15 inches, and the evaporation losses from Summit lake are great.

The station was established on May 25, 1911, by C. E. Richardson, and daily gauge readings were taken to September 30, 1911, when the creek went dry. Continuous gauge readings commencing April 13, 1912, were taken to the close of the irrigation season.

The measuring section is 100 yards from the highway from Grand Prairie to Ducks, two miles from Grand Prairie, and 50 yards above the gauge.

The gauge is a vertical staff gauge 5 feet long. Measurements are made with wading equipment from two planks thrown across the stream.

The banks are gently sloping, with no chance of overflow. The bed of the stream is of sand and gravel. Three bench-marks have been placed at the station, and their elevation referred to the datum of the gauge.

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DISCHARGE MEASUREMENTS of Essell Creek, near Grand Prairie, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
1911.							
May 25	C. G. Cline	1046	9·0	12·7	1·3	1·20	16·2
May 25	W. M. Carlyle	1044	10·0	11·4	1·7	1·30	19·5
May 25	C. E. Richardson	1048	11·0	14·6	1·4	1·21	16·2
June 5	"	1048	11·0	13·6	1·8	1·45	24·5
Aug. 24	W. M. Carlyle	1044	9·0	3·35	0·7	0·81	2·48
Aug. 24	"	1044	9·0	3·65	0·7	0·83	2·68
1912.							
May 10	C. E. Richardson	1048	11·0	15·4	2·1	1·80	32·7
July 15	"	1048	10·5	6·1	1·6	1·22	9·8
July 17	"	1048	10·0	5·7	1·6	1·18	8·8
Aug. 27	"	1049	9·0	2·8	0·9	0·98	2·6

DAILY GAUGE HEIGHT AND DISCHARGE from Essell Creek, near Grand Prairie, for 1911.

Day.	May.		June.		July.		August.		September.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1.			1·30	14·7	1·30	19·7	1·10	12·2	·75	0·3
2.			1·40	23·5	1·20	15·9	1·10	12·2	·75	0·3
3.			1·40	23·5	1·20	15·9	1·10	12·2	·75	0·3
4.			1·40	23·5	1·20	15·9	1·10	12·2	·75	0·3
5.			1·42	24·3	1·20	15·9	1·10	12·2	·75	0·3
6.			1·42	24·3	1·20	15·9	1·00	8·7	·75	0·3
7.			1·41	23·0	1·20	15·9	1·00	8·7	·75	0·3
8.			1·40	23·5	1·20	15·9	1·00	8·7	·7	0
9.			1·40	23·5	1·20	15·9	1·00	8·7	·7	0
10.			1·40	23·5	1·25	17·8	1·00	8·7	·7	0
11.			1·40	23·5	1·10	12·2	1·00	8·7	·7	0
12.			1·40	23·5	1·10	12·2	1·00	8·7	·7	0
13.			1·45	25·4	1·10	12·2	1·00	8·7	·7	0
14.			1·45	25·4	1·12	12·9	·95	7·0	·7	0
15.			1·42	24·3	1·15	14·0	·95	7·0	·7	0
16.			1·40	23·5	1·14	13·6	·95	7·0	·7	0
17.			1·40	23·5	1·15	14·0	·95	7·0	·7	0
18.			1·40	23·5	1·15	14·0	·95	7·0	·7	0
19.			1·40	23·5	1·12	12·9	·95	7·0	·7	0
20.			1·40	23·5	1·10	12·2	·95	7·0	·7	0
21.			1·40	23·5	1·12	12·9	·95	7·0	·7	0
22.			1·35	21·6	1·10	12·2	·90	5·2	·7	0
23.			1·35	21·6	1·22	16·7	·90	5·2	·7	0
24.			1·30	19·7	1·20	15·9	·90	5·2	·7	0
25.	1·30	19·7	1·30	19·7	1·20	15·9	·90	5·2	·7	0
26.	1·30	19·7	1·30	19·7	1·18	15·2	·80	2·0	·7	0
27.	1·30	19·7	1·30	19·7	1·18	15·2	·80	2·0	·7	0
28.	1·30	19·7	1·30	19·7	1·15	14·0	·80	2·0	·7	0
29.	1·30	19·7	1·28	18·3	1·15	14·0	·80	2·0	·7	0
30	1·30	19·7	1·25	17·8	1·10	12·2	·80	2·0	·7	0
31.	1·30	19·7			1·10	12·2	·80	2·0		

MONTHLY DISCHARGE of Essell Creek, near Grand Rapids, for 1911.

(Drainage area, 6 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	25	18	22	3·7	4·1	1,309	
July	20	12	15	2·5	2·9	922	
August	12	2	7	1·2	1·4	430	
September	0·3	0	·1	·01	·01	4·5	
The year							12

NOTE.—Creek ran dry on September 7. See note on 1912 sheet.
Accuracy, "B."

DAILY GAUGE HEIGHT AND DISCHARGE at Essell Creek, near Grand Prairie, for 1912.

Day.	April.		May.		June.		July.		August.		September.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·17	8·2	1·80	32·0	1·37	15·4		5·7		0·5
2			1·20	9·2		51·4	1·37	15·4		5·5		0·6
3			1·20	9·2	1·77	30·8	1·25	10·9		5·4		0·6
4			1·20	9·2	1·75	30·0	1·37	15·4	0·87	5·3	0·87	0·7
5				13·7	1·58	23·2	1·37	15·4		5·1		0·8
6			1·45	18·2	1·68	27·2	1·35	14·6		5·0		0·9
7	Creek dry.		1·45	18·2	1·68	27·2		13·7	0·90	4·9	0·90	1·0
8			1·50	20·2	1·75	30·0	1·30	12·7		4·7		
9			1·75	30·0	1·72	28·8	1·30	12·7		4·6		
10			1·82	33·0	1·72	28·8	1·27	11·6		4·4		
11			1·87	35·5		28·8	1·27	11·6		4·3		
12				33·0	1·72	28·8	1·27	11·6		4·2	Gauge read-	
13	0·80	0·0	1·77	30·8		28·6	1·27	11·6		4·0	ings discon-	
14		0·0		30·4		28·3		10·4		3·9	tinued	
15		0·0	1·75	30·0	1·70	28·0	1·2	9·2		3·8		
16	0·80	0·0		29·6	1·75	50·0	1·2	9·2		3·6		
17	0·85	0·5		29·2	1·75	30·0	1·17	8·2		3·5		
18		0·5	1·72	28·8	1·75	30·0	1·17	8·2		3·4		
19		0·6		27·4	1·70	28·0	1·17	8·2		3·3		
20		0·6	1·65	26·0	1·65	26·0	1·17	8·2		3·2		
21		0·7		26·0	1·65	26·0	1·15	7·6	1·0	3·1		
22	0·87	0·7	1·65	26·0	1·35	26·0	1·12	6·6		2·7		
23	0·87	0·7		26·9		26·0	1·12	6·6		2·4		
24	0·97	2·5		27·8	1·65	26·0	1·42	17·2	0·95	2·0		
25	0·97	2·5	1·72	28·8		28·0	1·10	6·0		1·7		
26	0·97	2·5		29·4	1·75	30·0	1·05	4·6		1·3		
27	0·95	2·0	1·75	30·0	1·44	18·9	1·05	4·6		0·9		
28	0·95	2·0	1·87	35·5	1·47	18·9		5·3	0·85	0·5		
29	0·95	2·0		33·7	1·45	18·2	1·10	6·0		0·5		
30		5·1	1·80	32·0		16·8	1·10	6·0		0·5		
31			1·80	32·0				5·8	0·85	0·5		

SESSIONAL PAPER No. 25f

MONTHLY DISCHARGE of Essell Creek, near Grand Prairie, for 1912.

(Drainage area, 6 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	5·1	0	0·8	0·13	0·14	48	
May	35·5	8·2	25·7	4·3	5·0	1,580	
June	32	16·8	27·0	4·5	5·0	1,610	
July	17·2	4·6	10·0	1·7	2·0	615	
August	5·7	0·5	3·4	0·6	0·7	210	
The period							15

NOTE.—In considering run-off it must be borne in mind that the natural flow of the stream is augmented by a diversion from Monte creek to Summit lake. The given figures for run-off per square mile, etc., are therefore larger than they would be under natural conditions.

Accuracy, "B."

FORTUNES CREEK (309).

Fortunes creek, often called Davis creek, is a stream about 15 miles long, rising in the hills about 3 miles northeast of Armstrong at an elevation of 3,500 feet, and discharging into Shuswap river, near Enderby, B.C., in township 18, range 9, west 6th meridian. It is part of the Shuswap-Thompson drainage.

The mean annual precipitation in Fortunes creek drainage is about 20 inches. The snowfall is about 6 feet. Very little irrigation is necessary. The maximum temperature is about 100° F., and the minimum about –25° F.

It is from this creek that the city of Armstrong obtains its water supply (200,000 imperial gallons per day), and power to develop its electric light plant. An average peak load of 63 horse-power is obtained with a 540-foot head and very small pondage. Owing to the small flow in the winter the present storage is not satisfactory, and investigations are being made farther up the creek. If sufficient storage is obtained it is intended to use water from this creek for irrigation purposes on land around Armstrong.

A regular gauging station was established on this creek by C. E. Richardson on August 29, 1911, one mile below the intake, for the city of Armstrong water supply, and immediately above the C.P.R. bridge, 1½ miles north of Armstrong. The gauge is a vertical staff, 5 feet long, fastened to the piles beneath the highway bridge. During extreme high water, measurements are made from the C.P.R. bridge, but during other stages by wading. Due to a tendency for the channel to shift in the gauging section the accuracy of the results cannot be too closely relied upon.

DISCHARGE MEASUREMENTS of Fortunes Creek, near Armstrong, B.C., 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
1911.							
Aug. 29	C. E. Richardson	1048				0·82	4·1
Oct. 9	" "	1048				0·80	2·4
1912.							
May 21	C. E. Richardson	1048	30	39	4·1	1·76	159
June 15	" "	1048	52	48	4·6	2·01	219
June 20	" "	1048	22	23	3·8	1·00	86
July 12	" "	1048	17	13	1·2	0·53	15·6
Sept. 7	" "	1049	13	7·7	1·8	0·6	13·9
Oct. 5	" "	1055	6·4	1·5	1·2	0·26	1·8

DAILY GAUGE HEIGHT AND DISCHARGE of Fortunes Creek, near Armstrong, for 1911.

Day.	August.		September.		October.		November.		December.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·8	2·4	0·8	2·4	0·75	1·7	0·7	1·0
2			0·8	2·4	0·8	2·4	0·75	1·7	0·7	1·0
3			0·85	3·8	0·8	2·4	0·75	1·7	0·7	1·0
4			0·8	5·1	0·78	2·1	0·78	2·1	0·7	1·0
5			0·85	3·8	0·75	1·7	0·8	2·4	0·68	·8
6			0·82	2·9	0·72	1·3	0·8	2·4	0·65	·7
7			0·9	5·1	0·7	1·0	0·8	2·4	0·65	·7
8			0·9	5·1	0·8	2·4	0·8	2·4	0·65	·7
9			0·88	4·6	0·78	2·1	0·82	2·9	0·72	1·4
10			0·85	3·8	0·75	1·7	0·8	2·4	0·72	1·4
11			0·82	2·9	0·72	1·4	0·8	2·4	0·68	·9
12			0·85	3·8	0·72	1·4	0·8	2·4	0·65	·7
13			1·0	10·2	0·70	1·0	0·8	2·4	0·60	·4
14			0·95	7·6	0·9	5·1	0·8	2·4	0·7	1·0
15			0·95	7·6	0·9	5·1	0·8	2·4	0·7	1·0
16			0·95	7·6	0·9	5·1	0·8	2·4	0·7	1·0
17			0·95	7·6	0·88	4·6	0·72	1·3	0·6	·4
18			0·9	5·1	0·88	4·6	0·78	2·1	0·6	·4
19			0·9	5·1	0·85	3·8	0·8	2·4	0·62	·5
20			0·95	7·6	0·8	2·4	0·8	2·4	0·6	·4
21			0·85	3·8	0·8	2·4	0·78	2·1	0·6	·4
22			0·9	5·1	0·8	2·4	0·78	2·1	0·6	·4
23			0·85	3·8	0·8	2·4	0·75	1·7	0·6	·4
24			0·88	4·6	0·85	3·8	0·78	2·1	0·6	·4
25			0·85	3·8	0·85	3·8	0·80	2·4	0·6	·4
26			0·82	2·9	0·85	3·8	0·8	2·4	0·6	·4
27			0·88	4·6	0·82	2·9	0·78	2·1	0·6	·4
28			0·8	2·4	0·80	2·4	0·75	1·7	0·60	·4
29	0·8	2·4	0·9	5·1	0·8	2·4	0·7	1·0	0·57	·3
30	0·8	2·4	0·8	2·4	0·82	2·9	0·75	1·7	0·6	·4
31	0·85	3·8			0·78	2·1			0·6	·4

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MONTHLY DISCHARGE of Fortunes Creek, Armstrong, for September to December, 1911.

(Drainage area above station, 20 square miles.)

Month.	DISCHARGE IN SECOND FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
September	10·2	2·4	4·7	·24	·27	283	
October	5·1	1·0	2·7	·14	·16	169	
November	2·9	1·0	2·1	·11	·12	127	
December	1·4	·3	·67	·03	·03	40	
The period							18

NOTE.—The above results are deduced from measurements made in 1911 and 1912 by means of curve No. 1. The above figures do not include the 200,000 gallons per day used by the City of Armstrong for water supply, so to the mean monthly discharge must be added 0·5 second-feet.

Accuracy, "B" for September and October; "C" for November and December.

DAILY GAUGE HEIGHT AND DISCHARGE of

DAY.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1....	0·6	·4	0·7	1·0	0·7	1·0	0·75	1·7	1·0	10·2	1·3	47·
2....	0·6	·4	0·7	1·0	0·7	1·0	0·78	2·1	1·0	10·2	1·25	39
3....	0·6	·4	0·7	1·0	0·7	1·0	0·78	2·1	1·0	10·2	1·08	17·2
4....	0·6	·4	0·7	1·0	0·7	1·0	0·8	2·4	1·05	14·6	1·1	19·0
5....	0·6	·4	0·68	·9	0·68	·9	0·8	2·4	1·1	19·0	1·05	14·6
6....	0·6	·4	0·68	·9	0·7	1·0	0·8	2·4	1·18	29·0	1·08	17·2
7....	0·58	·4	0·65	·7	0·7	1·0	0·8	2·4	1·2	21·0	1·0	10·2
8....	0·6	·4	0·7	1·0	0·7	1·0	0·8	2·4	1·22	34·0	1·3	47·0
9....	0·7	1·0	0·68	·9	0·75	1·7	0·78	2·1	1·28	44·0	1·4	65·0
10....	0·7	1·0	0·68	·9	0·75	1·7	0·8	2·4	1·2	31·0	1·25	39·0
11....	0·7	1·0	0·68	·9	0·7	1·0	0·88	4·6	1·25	39·0	1·32	54·6
12....	0·7	1·0	0·68	·9	0·7	1·0	0·8	2·4	1·3	47·0	1·42	69·
13....	0·7	1·0	0·65	·7	0·7	1·0	0·78	2·1	1·3,	56·0	1·58	105·
14....	0·6	·4	0·7	1·0	0·75	1·7	0·75	1·7	1·5	87·0	1·6	110
15....	0·6	·4	0·7	1·0	0·75	1·7	0·75	1·7	1·4	65·6	2·02	229
16....	0·58	·4	0·75	1·7	0·78	2·1	0·75	1·7	1·5	87·0	1·5	222
17....	0·5	·2	0·7	1·0	0·75	1·7	0·75	1·7	1·48	82·0	1·3	163
18....	0·5	·2	0·75	1·7	0·75	1·7	0·8	2·4	1·5	87·0	1·2	135
19....	0·5	·2	0·75	1·7	0·7	1·0	0·9	5·1	1·58	105·0	1·08	103
20....	0·5	·2	0·78	2·1	0·7	1·0	0·9	5·1	1·62	115	0·95	74
21....	0·5	·2	0·75	1·7	0·7	1·0	0·9	5·1	1·8	164	0·9	63
22....	0·52	·2	0·75	1·7	0·75	1·7	0·95	7·6	1·6	110	0·85	54
23....	0·52	·2	0·75	1·7	0·78	2·1	0·95	7·6	1·7	136	0·8	45
24....	0·55	·3	0·78	2·1	0·78	2·1	0·95	7·6	1·8	164	0·7	30
25....	0·55	·3	0·78	2·1	0·75	1·7	1·0	10·2	1·8	164	0·7	30
26....	0·6	·4	0·78	2·1	0·75	1·7	0·98	9·2	2·0	223	0·65	24
27....	0·6	·4	0·7	1·0	0·75	1·7	0·98	9·2	1·9	193	0·6	18
28....	0·6	·4	0·7	1·0	0·7	1·0	0·98	9·2	1·8	164	0·65	24
29....	0·65	·7	0·7	1·0	0·78	2·1	0·98	9·2	1·6	110	0·68	28
30....	0·68	·9	.....	.....	0·75	1·7	1·0	10·2	1·5	87	0·7	30
31....	0·7	1·0	.....	.....	0·75	1·7	.....	.....	1·4	65	.....	.....

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Fortunes Creek, near Armstrong, for 1912.

July.		August.		September.		October.		November.		December.		Day.
Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge.	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet	Sec.-ft.	Feet.	Sec.-ft.	
0·75	37·5	0·4	4·9		7·0		1·7	0·25	1·7	0·28	2·1	1
0·78	42·0		7·0	0·48	9·0	0·25	1·7		1·7		2·1	2
0·7	30·0	0·48	9·0		8·2		1·7	0·25	1·7	0·28	2·1	3
0·68	27·6		5·7	0·45	7·4	0·25	1·7		1·7		2·1	4
0·68	18·0	0·3	2·4		8·2		1·7	0·25	1·7	0·28	2·1	5
0·6	18·0		2·4	0·48	9·0	0·25	1·7		1·7		1·9	6
0·58	16·4	0·3	2·4		8·2		1·7	0·25	1·7	0·25	1·7	7
0·58	16·4		2·4	0·45	7·4	0·25	1·7	0·28	2·1		1·7	8
0·55	14·0	0·3	2·4		6·6		1·7	0·28	2·1	0·25	1·7	9
0·58	16·4		2·6	0·42	5·9	0·25	1·7		1·9		1·9	10
0·52	11·6	0·32	2·9		5·4		1·9		1·9	0·23	2·1	11
0·52	11·6		3·4	0·4	4·9	0·28	2·1	0·25	1·7		2·1	12
0·65	24·0	0·36	3·9		4·9		1·9		2·0	0·23	2·1	13
0·6	18·0		4·4	0·4	4·9	0·25	1·7	0·3	2·4		1·9	14
	18·0	0·4	4·9		4·6		1·7		2·4	0·25	1·7	15
0·6	18·0		7·4	0·38	4·4	0·25	1·7	0·3	2·4		1·7	16
	17·2	0·5	10·0		4·4		3·3		2·4	0·25	1·7	17
0·58	16·4		12·0	0·38	4·4	0·4	4·9	0·3	2·4		1·4	18
	16·4	0·55	14·0		3·4		4·9		2·4	0·2	1·0	19
0·58	16·4		12·0	0·3	2·4	0·4	4·9	0·3	2·4		1·0	20
	17·2	0·5	10·0		2·4		4·2		2·4	0·2	1·0	21
0·6	18·0		8·7	0·3	2·4	0·35	3·6	0·3	2·4		1·0	22
	18·9	0·45	7·4		2·4		3·6		2·2	0·2	1·0	23
0·6	18·0		5·2	0·3	2·4	0·35	3·6	0·28	2·1		1·0	24
	23·0	0·32	2·9		2·6		3·2		2·1	0·2	1·0	25
0·68	28·0		2·6	0·32	2·9	0·32	2·9	0·28	2·1		·8	26
	19·0	0·3	2·4		2·0		2·9		1·9	0·15	·7	27
0·5	10·0		2·6	0·2	1·0	0·32	2·9	0·25	1·7		·8	28
	9·5	0·32	2·9		1·4		2·7		1·7	0·2	1·0	29
0·48	9·0		3·9	0·25	1·7	0·3	2·4	0·25	1·7		1·0	30
	7·0	0·4	4·3				2·1			0·2	1·0	31

Monthly Discharge of Fortunes Creek, near Armstrong, B.C., for 1912.

(Drainage area above station, 20 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
January	1·0	·2	·5	0·02	0·023	31	
February	2·1	·7	1·2	0·06	0·065	69	
March	2·1	·9	1·4	0·07	0·08	86	
April	10·2	1·7	4·5	0·22	0·24	268	
May	223	10·2	83·4	4·20	4·80	5,130	
June	229	10·2	64·0	3·20	3·60	3,810	
July	42	7·0	18·7	0·94	1·10	1,150	
August	14	2·4	5·5	0·24	0·32	338	
September	9·0	1·0	4·7	0·24	0·27	280	
October	4·9	1·7	2·6	0·13	0·15	160	
November	2·4	1·7	2·0	0·10	0·11	119	
December	2·1	0·7	1·5	0·08	0·08	92	
The year	229	0·2	16·8	0·78	10·8	11,533	18

Note.—The above results are deduced from measurements made in 1911 and 1912 by means of curve No. 1 up to June 15, and curve No. 2 from June 16 to December 31. The above figures do not include the 200,000 gallons per day used by the city of Armstrong for water supply, so to the mean monthly discharge must be added 0·5 second-foot.

Accuracy, "C" for January, February, June and December; "B" for the remaining months.

Fraser River (101 and 102).

Fraser river has its source in Yellowhead pass at an elevation of 3,710 feet, and after flowing some 700 miles in general southwesterly direction, discharges into the Pacific (Strait of Georgia) near New Westminster. Of its length, the lower 175 miles is within the railway belt. The important tributaries within the belt are Pitt river, Stave river, Sumas river, Harrison river, Nahatlatch (or Salmon) river, Silver-hope creek, Coquihalla river, Steen creek, and Thompson river, the last named being the largest confluent.

The drainage area of Fraser river is about 90,000 square miles. The report on the Water-powers of Canada, issued by the Commission of Conservation, 1911, gives it as 91,700 square miles. The said report also gives an interesting article on the Fraser river in the chapter on British Columbia.

The drainage area of Fraser river above Lytton, (*i.e.*, the mouth of Thompson river) is 63,000 square miles.

The drainage area of Fraser river above the gauging station at Hope (below the mouth of Coquihalla river) is 85,600 square miles.

The Fraser is important for fishing, navigation and lumbering. There are some millions of latent horse-power in the river, particularly in the Fraser canyon, but it is improbable that the river will be harnessed in the near future. A company now has a project for developing power at Hell's Gate, near Yale, where the river runs through a narrow canyon, and the difference between extreme high water and low water is about 100 feet.

Fraser river is the largest stream lying wholly in British Columbia, and it has played a very important part in the development of the province. It was the discovery of gold in the bed of the Fraser river that brought large numbers of men into the

country; and it was the gradual movement of the gold seekers up the valley that opened up the country and led to the building of roads and bridges. When the C.P.R. was built it followed the Fraser for 150 miles, and the Thompson, a tributary of the Fraser, for as many more. The C.N.R. follows the Fraser and Thompson to Kamloops, goes up the North Thompson, strikes across the divide to the upper Fraser again and follows it to the Yellowhead pass. The Grand Trunk Pacific follows the Upper Fraser river from Yellowhead pass for 300 miles. And the proposed Pacific Great Eastern will follow the Fraser river for 200 miles or more. Since the railways are the most important factors in developing a country, rich in natural resources, the valleys of the Fraser river and its tributaries will necessarily continue to be of great importance.

Probably the most important industry directly connected with the Fraser river is the fishing. Salmon of various kinds come in from the salt water in countless numbers in the fall and swarm up the Fraser river, heading for the spawning grounds on the smaller rivers and creeks. Great numbers of them are caught near the mouth of the Fraser, and large canneries are situated there; and salmon are caught on all parts of the Fraser and on all the streams that flow into it. In the winter dried fish is the staple diet of the Fraser River Indians.

British Columbia is essentially a mountainous country, and the watershed of the Fraser follows the general rule. As a result, the amount of land suitable for agriculture is relatively small. It is found mostly in small flats and benches along the Fraser and its tributaries; and sometimes a valley will widen out and give a larger expanse of good land, as in the case of the Nicola valley, where there are several townships of good land in a block. Many of the small flats contain excellent land, and some of them in the Dry Belt are well sheltered and make excellent fruit land. But the richest land in the whole province is the delta land near the mouth of the Fraser river, of which Lulu island is a good example.

In the days of the gold rush, before the Canadian Pacific Railway was built, steamers used to run up the Fraser as far as Yale, which is 100 miles from the coast. And during the construction of the Canadian Northern, supplies were distributed by steamer as far as Yale. But, as a rule, navigation on the Fraser is now confined to the fifty-mile stretch from Chilliwack to the mouth. This part of the stream is tidal, and river steamers make regular trips between New Westminster and Chilliwack, calling at many points on both sides of the river on the way. But the construction of railways, and electric lines is rendering the river transportation less important than formerly.

On the other hand, the importance of the Fraser river as a port for ocean shipping is increasing. In the early days, New Westminster was the only port on the mainland, and there was sufficient water over the bar for the ships of those days. But with the coming of the Canadian Pacific Railway to Burrard inlet and the increase in the draught of ocean-going vessels, the Fraser river became of secondary importance. Now, however, jetties are being built at the mouth of the river so that the stream will keep its channel secured clean, and dredging is being done where necessary. In Burrard inlet most of the suitable waterfront is in use, and all of it is held at high prices, while along the Fraser river there are miles of good waterfront lying idle. New Westminster is starting on an extensive harbor improvement programme, and intends to improve the waterfront along the city and to build docks on Annan's island. The Canadian Northern Railway is planning for a town at Port Mann, where for two miles or more there is deep water close to the shore. An industrial city seems to be starting around the Canadian Pacific Railway yards at Coquitlam, and harbour surveys are being made along the Fraser and Pitt rivers. So that it is probable the Fraser will develop into a fresh water harbour of considerable importance.

Lumbering is one of the chief industries of British Columbia, and there is a good

deal of timber in the Fraser river watershed. The best timber is near the coast, where fir and cedar grow to immense sizes. But most of the watershed is covered with timber of some kind. In the Dry Belt, the lower benches are often bare, but there are generally trees on the hills. In the mountains there are trees on the lower hills, though the higher peaks may rise above timber line. In the Cariboo district, there has been cut only what timber was required for local use. The same is practically true of the Dry Belt. But at the coast, in addition to supplying the large local demand, a great deal of timber is shipped by rail to the prairie, and by water to Australia, South America and the Orient. The longest sizes of cedar poles are sent by rail, even as far east as Ontario. The logs are floated down to navigable water, where they are made into rafts and towed to the mills. There are several mills on the Fraser river, and one of them is said to be the largest in the world; but a good deal of the timber they use is cut outside the Fraser watershed. Up to the present the timber that has been cut is that in the lower parts of the valleys, where it has been within easy reach of the water. But before long it will be necessary to build logging railroads to the head-waters; and the cutting of the timber there, unless done under careful supervision, with provision for reforestation, will affect the regimen of the streams.

There are no very good power sites on the Fraser river inside the Railway Belt, though many of its tributaries have excellent ones. There are no falls on the river, and no very heavy rapids. There are places in the canyon where 30 or 40 feet of head could be obtained by means of a dam. But there is a railroad on each side of the river, not far above the high water line as it is at present, and it would be found very difficult to take care of the heavy flood discharge in the narrow canyon.

The Fraser river empties into the Gulf of Georgia, and at the mouth it rises and falls with the tides; this tidal influence extends up the river with diminishing effect until it becomes almost negligible at Agassiz, 70 miles from the mouth. The tide rises several feet in Pitt river, and Pitt lake also. Hence, during ordinary stages of the Fraser, there is quite a current upstream past New Westminster when the tide is rising. This is of importance in connection with navigation, water supply and sewage disposal.

At New Westminster the Fraser is a magnificent stream, being more than half a mile in width, with the main channel about 40 feet deep. In addition to the ordinary flow of the stream, there is the ebb and flow of the tidal water. Near Hope, 90 miles from the mouth, the river varies from 700 to 1,000 feet in width, is 40 feet deep, in places, at low water, and at high water rises 20 feet above the low-water mark. The maximum discharge in 1912 was 220,000, the minimum 13,000, and the mean for the year about 70,000 cubic feet per second. At Yale, 100 miles from the mouth, the canyon begins and the river is confined between solid rock walls. In many places it is only two or three hundred feet wide, and varies in depth at low water from 20 to 80 feet. During the flood it sometimes rises in certain confined parts of the canyon as much as 100 feet above the low-water mark. This canyon extends for about 30 miles, and presents a very imposing appearance. Above the canyon the banks are still high, but the rock is not so much in evidence. At Lytton, 150 miles from the mouth, the Thompson river enters; and above the mouth of the Thompson, the Fraser is not so large. It is from 300 to 700 feet wide, 15 feet deep at low water and at high water rises 25 feet above the low-water mark. The maximum discharge for 1912 was 173,000, the minimum, 6,800 and the mean about 50,000 cubic feet per second.

Near Tête Jaune Cache, 50 miles from the summit, the altitude is 2,400 feet. Between that point and Fort George the stream is navigable during high water. The altitude at this latter point is 1,900 feet, a descent of 500 feet in about 200 miles. Near Fort George the Fraser river turns south. Steamers make regular trips on the 120-mile stretch between Fort George and Soda creek. At Lillooet, 130 miles farther south, the elevation is 665 feet. Near Lytton, 40 miles from Lillooet, the mean eleva-

tion is about 450 feet. Yale is 53 miles from Lytton and about 100 miles from the gulf of Georgia; the elevation of the water at the average height is 170 feet. At Hope, 13 miles south of Yale, the Fraser begins to turn in a westerly direction; its elevation is about 125 feet. From Agassiz, 19 miles below Hope, the course is almost directly west to the gulf of Georgia. The elevation of the river at Agassiz is about 60 feet. For the last fifty miles from Chilliwack to the mouth the stream is affected more or less by the tides.

Fraser River at Hope (101).

A gauging station was established on Fraser river at Hope on March 1, 1912, by C. G. Cline. This spot was chosen instead of one lower down the river to make sure that there would be no tidal influence, either from the tide itself or its effect on the flood waters of the Fraser.

The station is above the mouth of Coquihalla river, at the rock point below the Hope ferry landing. The measuring section at low and medium stages is at the gauge, and the measurements are made by current meter suspended by a mild steel cable with an insulated core, 30 pounds of lead used. A motor or row-boat is anchored in the river just under the telephone wire above the ferry crossing. The boat is anchored in the true section, and its location is determined by transit from the shore, by means of a measured base and observed angles.

At high water the measurements are made at Yale, 15 miles above Hope, from a cable and car, constructed by the Canadian Northern Railway.

The gauge is painted on the rocky bank on the above-mentioned rock point near the ferry landing, on the left bank. The gauge is graduated in feet, and estimated to tenths, by the gauge reader, Capt. Smith, who runs the motor ferry. The datum of the gauge was referred to three bench-marks.

The minimum flow of the Fraser takes place in the latter part of February or early in March. In 1912, the minimum was 13,000 c.f.s.

The river at the gauging station is 16 feet deep at low water and 35 feet deep at high water.

The section is from 700 to 1,000 feet wide. The mean velocity varies from 1·3 feet per second at low water to about 6 or 7 feet per second at high water. At the high-water section at Yale, the mean velocity at the flood period is about 9 feet per second.

The flood occurs toward the end of June, and lasts for nearly two weeks. The maximum discharge during 1912 occurred on June 24, and was 216,000 c.f.s.

Open channel conditions exist all year.

Discharge Measurements of Fraser River, at Hope, 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
Mar. 5	C. G. Cline	1046	690	14,400	1·3	10·0	18,280
June 6	C. G. Cline, B. Corbould	1046	1,000	19,800	6·8	21·0	135,700
June 28	C. G. Cline	1046	710	26,500	8·5	24·5	225,000*
Sept. 24	"	1046	885	17,200	4·0	14·7	69,950
Sept. 26	"	1046	575			14·0	73,400*

* Measured at Yale.

DAILY GAUGE HEIGHT AND DISCHARGE

DAY.	MARCH.		APRIL.		MAY.		JUNE.		JULY.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge heig.t.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-f..
1.	.....	15,000	10·2	20,000	14·9	65,000	23·0	182,000	23·3	186,000
2.	.....	15,000	10·7	24,000	15·2	69,000	23·0	182,000	22·0	182,000
3.	.....	15,000	10·5	22,000	16·0	79,000	22·7	176,000	22·7	176,000
4.	.....	15,000	10·7	24,000	16·7	87,000	22·0	166,000	21·3	154,000
5.	.....	15,000	10·7	24,000	17·0	92,000	21·5	158,000	21·9	164,000
6.	10·0	18,000	10·7	24,000	17·5	95,000	21·0	150,000	21·1	151,000
7.	9·7	15,000	10·9	26,000	17·6	100,000	20·8	146,000	20·9	148,000
8.	9·7	15,000	11·0	27,000	18·0	106,000	20·9	148,000	20·9	148,000
9.	9·6	15,000	11·1	28,000	18·5	113,000	20·7	144,000	20·8	146,000
10.	9·6	15,000	11·2	29,000	18·9	118,000	20·7	144,000	20·8	146,000
11.	9·6	15,000	11·2	29,000	19·2	122,000	20·8	146,000	20·5	142,000
12.	9·6	15,000	11·5	51,000	19·7	129,000	21·2	152,000	20·0	134,000
13.	9·6	15,000	11·6	32,000	19·9	132,000	21·7	160,000	20·2	136,000
14.	9·5	14,000	11·7	33,000	19·9	132,000	21·9	164,000	20·2	136,000
15.	9·4	14,000	11·9	35,000	20·1	135,000	22·0	166,000	20·3	137,000
16.	9·5	14,000	12·0	36,000	21·7	160,000	22·8	178,000	20·8	146,000
17.	9·6	15,000	12·7	43,000	21·7	160,000	23·0	182,000	20·5	142,000
18.	9·7	15,000	12·5	41,000	22·0	166,000	23·7	192,000	20·1	135,000
19.	9·7	15,000	12·7	43,000	23·5	190,000	23·5	190,000	19·9	132,000
20.	9·6	15,000	13·0	46,000	23·6	191,000	23·8	194,000	19·8	130,000
21.	9·7	15,000	13·2	48,000	23·7	192,000	24·2	200,000	19·7	129,000
22.	9·6	15,000	13·5	51,000	23·5	190,000	24·9	212,000	19·6	128,000
23.	9·5	14,000	13·8	54,000	22·8	178,000	25·1	215,000	19·7	129,000
24.	9·5	14,000	14·0	56,000	23·2	184,000	25·2	216,000	19·5	127,000
25.	9·3	13,000	14·0	56,000	24·0	198,000	25·2	216,000	19·7	129,000
26.	9·7	15,000	14·1	57,000	24·1	199,000	24·8	210,000	19·8	130,000
27.	9·8	16,000	14·5	61,000	24·2	200,000	24·5	207,000	19·8	130,000
28.	10·1	19,000	14·7	63,000	24·0	198,000	24·5	207,000	19·5	127,000
29.	10·2	20,000	14·8	64,000	24·0	198,000	24·0	198,000	19·1	121,000
30.	10·0	18,000	15·0	67,000	23·7	192,000	23·5	190,000	19·0	120,000
31.	19·9	17,000	.....	.....	23·5	190,000	.....	.....	19·1	121,000

of Fraser River, at Hope, for 1912.

August.		September.		October.		November.		December.		Day.
Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
18·9	118,000	17·0	92,000	13·3	49,000	12·6	42,000	11·4	30,000	1
18·8	116,000	16·7	87,000	13·5	51,000	12·5	41,000	11·5	31,000	2
18·8	116,800	16·7	87,000	13·5	51,000	12·4	40,000	11·3	30,000	3
18·9	118,000	16·5	85,000	13·2	48,000	12·2	38,000	11·4	30,000	4
19·1	121,000	16·9	79,000	13·0	46,000	12·1	37,000	11·5	31,000	5
19·1	121,000	15·9	77,000	13·5	51,000	12·0	36,000	11·3	30,000	6
19·0	120,000	15·8	76,000	14·0	56,000	12·2	38,000	11·4	30,000	7
18·9	118,000	15·7	75,000	14·9	65,000	12·1	37,000	11·2	29,000	8
19·0	120,000	15·7	75,000	14·2	59,000	12·2	38,000	11·0	27,000	9
19·1	121,000	15·5	73,000	14·2	58,000	12·2	38,000	11·0	27,000	10
18·9	118,000	15·7	75,000	14·1	57,000	12·1	37,000	11·1	28,000	11
18·9	118,000	15·5	73,000	14·2	58,000	12·0	36,000	11·2	29,000	12
19·0	120,000	15·6	74,000	14·2	58,000	12·8	44,000	11·4	30,000	13
19·5	127,000	15·2	63,000	14·0	56,000	12·4	40,000	11·4	30,000	14
19·5	127,000	14·9	65,000	14·0	56,000	12·2	38,000	11·2	29,000	15
19·3	123,000	15·0	67,000	13·8	54,000	12·2	38,000	11·1	28,000	16
18·7	115,000	15·0	67,000	14·0	56,000	11·9	35,000	10·9	26,000	17
18·5	113,000	15·0	67,000	13·8	54,000	12·1	37,000	10·9	26,000	18
18·5	113,000	14·9	65,000	13·7	53,000	12·9	45,000	10·8	25,000	19
18·7	115,000	14·8	64,000	13·7	53,000	12·4	40,000	10·7	24,000	20
18·7	115,000	14·8	64,000	13·8	54,000	12·2	41,000	10·7	24,000	21
18·7	115,000	14·7	63,000	13·5	51,000	12·5	41,000	10·7	24,000	22
18·7	115,000	14·5	61,000	13·5	51,000	12·8	44,000	10·8	25,000	23
18·9	118,000	14·4	60,000	13·3	49,000	12·7	43,000	10·9	26,000	24
19·1	121,000	14·2	58,000	13·3	49,000	12·4	40,000	10·8	25,000	25
19·7	129,000	14·0	56,000	13·5	49,000	11·9	35,000	11·0	27,000	26
19·7	129,000	14·0	56,000	13·0	46,000	11·8	34,000	10·7	24,000	27
19·3	123,000	14·0	56,000	12·8	44,000	11·8	34,000	10·9	26,000	28
18·0	106,000	13·8	54,000	13·0	46,000	11·7	33,000	11·0	27,000	29
17·9	104,000	13·5	51,000	12·9	45,000	11·6	32,000	11·1	28,000	30
17·5	99,000	....		12·7	43,000			11·2	29,000	31

Monthly Discharge of Fraser River, at Hope, for 1912.

(Drainage area, 85,600 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
March	20,000	13,009	15,355	0·20	0·22	944,000
April	67,000	20,000	39,800	0·50	0·60	2,370,000
May	200,000	65,000	147,097	1·70	2·00	9,040,000
June	216,000	144,000	179,700	2·10	2·30	10,700,000
July	186,000	120,000	140,710	1·70	2·00	8,650,000
August	129,000	99,000	118,000	1·40	1·60	7,260,000
September	92,000	51,000	69,035	0·80	0·90	4,100,000
October	65,000	43,000	52,129	0·60	0·70	3,200,000
November	44,000	52,000	38,300	0·40	0·50	2,280,000
December	31,000	24,000	27,581	0·30	0·35	1,695,000

Note.—Accuracy, "B."

Fraser River and Lytton (102).

A station was established on Fraser river at Lytton, above the mouth of Thompson river, on February, 1912, by C. G. Cline.

The gauge is painted in black on white on a huge black rock on the left bank, 200 feet above the ferry cable, a mile and a quarter above Lytton.

The datum of the gauge is referred to three bench-marks. The measuring section is 75 feet below the said cable. The initial point for soundings is a hub on the bar on the left side of the river. The said hub is under water at the higher stages, but the east face of the bottom cross timber of the cable tower on the right bank is the 860-foot mark.

Measurements are made by current meter suspended from a cable, with 30 pounds of lead. Measurements are made from the ferry, and the distance from the initial point determined by transit from the shore.

The river is in one channel. Above the station, the channel is straight for over 200 yards, and below it is straight for 400 feet. The Thompson river enters a mile below but has no effect on the section.

The bed of the river is permanent, with flat rocks and sand. The banks are not liable to overflow. It is a good section, except that the water is very swift at high stages.

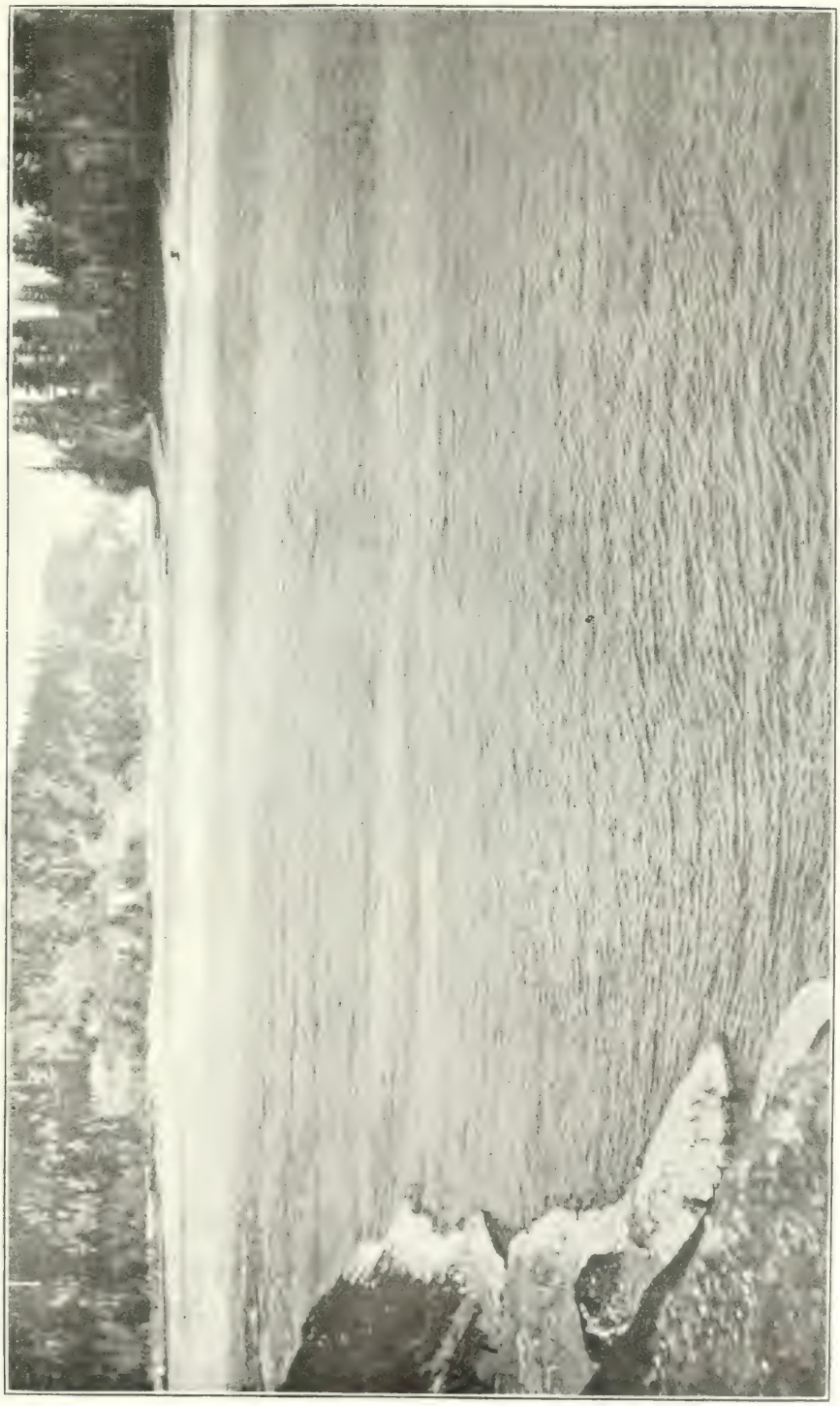
The measuring section is from 300 to 675 feet wide. The depth varies from 15 feet to over 40 feet between high and low water. The mean velocity at low water is about 4·4 feet per second, and at high water, is over 10 feet per second.

Open channel conditions exist all year. The minimum flow during 1912 occurred on February 29, and was 6,800 c.f.s.

The maximum occurred on June 25, and was 173,000 c.f.s. This is greatly below the average flood.

Discharge Measurements of Fraser River, at Lytton, 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
Feb. 20	C. G. Cline	1046	315	2,850	4·4	10·0	12,300
Mar. 26	"	1046	310	2,803	4·1	9·4	11,500
May 31	"	1046	650	14,600	9·7	32·7	141,000
June 26	"	1046	675	16,100	10·1	34·3	162,000
July 25	"	1046	525	9,180	10·2	23·6	94,000
Sept. 29	"	1046	425	4,835	7·0	15·0	34,000



Gauging Station on Fraser River, near Lytton, B.C.

GAUGE HEIGHT AND DAILY DISCHARGE

DAY.	FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1				7,800	9·5	10,800	18·0	51,200	30·0	126,500
2			9·0	8,800		12,400	19·0	56,800	29·0	119,800
3				8,800		14,000		62,600	28·0	113,200
4				8,800		15,600	21·0	68,500	27·0	106,600
5			9·0	8,800		17,200		65,500	26·0	100,000
6				8,800	11·5	18,900	20·0	62,500	24·0	87,000
7				8,800		19,400	20·0	62,500	24·0	87,000
8				8,800		19,900		68,500	24·0	87,000
9				8,800		20,400	22·0	74,500	23·0	80,700
10			9·0	8,800	12·0	21,000	22·0	74,500	23·0	80,700
11				8,800		23,200	23·0	80,700	24·0	87,000
12				8,800	13·0	25,500		80,700	25·0	93,500
13			9·0	8,800	13·5	27,900	23·0	80,700	26·0	100,000
14				9,100		28,700	23·0	80,700	27·0	106,600
15				9,400		29,500	24·0	87,000	28·0	113,200
16				9,700	14·0	30,300	25·5	96,750	29·0	119,800
17				10,000		31,500	27·0	106,600	30·0	126,500
18				10,400	14·5	32,800	29·0	119,800	31·0	133,500
19			9·5	10,800		35,400		126,600	29·0	119,800
20	10·5	14,800		10,800	15·5	37,850	31·0	133,500	30·0	126,500
21		13,800		10,800		39,100	29·0	119,800	32·0	140,500
22		12,800	9·5	10,800	16·0	40,400	28·0	113,200	35·0	162,000
23		11,800	10·0	12,800		41,300	28·0	113,200	36·0	169,500
24	9·5	10,800		10,800		42,200	28·0	113,200	36·0	169,500
25		10,100	9·0	8,800	16·5	43,000	29·0	119,800	36·5	175,000
26		9,400	9·5	10,800		45,700		126,600	34·0	155,500
27	9·0	8,800		10,800	17·5	48,400	31·0	133,500	34·0	155,500
28		7,800	9·5	10,800		49,300	33·0	148,000	33·0	148,000
29	8·5	6,800		10,800		50,200	34·0	155,500	32·0	140,500
30				10,800	18·0	51,200	34·5	159,250		137,000
31				10,800			32·5	144,250		

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of Fraser River, at Lytton, for 1912.

July.		August.		September.		October.		November.		December.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
31·0	133,500	21·0	68,500	19·0	56,800	14·5	32,800		25,500	10·0	12,800	1
28·0	113,200	20·5	65,500	18·0	51,200	14·5	32,800		25,500	10·0	12,800	2
27·0	106,600	20·0	62,500	18·0	51,200	14·0	30,300	13·0	25,500	10·0	12,800	3
26·0	100,000	22·5	77,600	17·5	48,400	14·0	30,300	13·0	25,500	10·0	12,800	4
25·0	93,500	22·5	77,600	18·0	51,200	14·5	32,800	13·0	25,500	10·0	12,800	5
25·0	93,500	23·0	80,700	18·0	51,200	18·0	51,200	13·0	25,500	10·0	12,800	6
25·0	93,500	23·0	80,700	17·0	45,600	17·0	45,600	13·0	25,500	10·0	12,800	7
25·0	93,500	23·0	80,700	17·5	48,400	16·5	43,000	13·5	27,900	11·0	16,800	8
25·0	93,500	23·5	82,850	18·0	51,200	16·0	40,400	13·5	27,900	12·0	21,000	9
25·0	93,500	23·5	82,850	17·0	45,600	16·0	40,400	13·0	25,500	12·0	21,000	10
25·0	95,500	23·0	80,700	17·0	45,600	16·5	43,000	12·5	23,250	11·5	18,900	11
24·0	87,000	23·0	80,700	17·0	45,600	17·0	45,600	12·0	21,000	12·0	21,000	12
24·0	87,000	23·5	83,850	17·0	45,600	16·5	43,000	12·0	21,000	12·0	21,000	13
24·0	87,000	24·0	87,000	17·0	45,600	16·0	40,400	11·5	18,900	12·0	21,000	14
25·0	93,500	23·5	83,850	17·5	48,400	16·0	40,400	11·0	16,800	11·0	16,800	15
26·0	100,000	23·0	80,700	17·0	45,600	16·0	40,400	11·0	16,800	11·0	16,800	16
25·0	93,500	22·0	77,600	17·0	45,600	16·0	40,400	11·5	18,900	10·0	12,800	17
24·0	87,000	22·0	74,500	17·0	45,600	16·0	40,400	11·5	18,900	10·0	12,800	18
23·0	80,700	21·0	68,500	17·0	45,600	15·5	37,850	12·0	21,000	10·0	12,800	19
22·5	77,600	23·0	80,700	17·0	45,600	15·0	35,300	12·0	21,000	11·0	16,800	20
	76,000	23·0	80,700	16·0	40,400	15·0	35,300	12·0	21,000	10·0	12,800	21
22·0	74,500	23·0	80,700	16·0	40,400	15·0	35,300	12·5	23,250	10·0	12,800	22
23·0	80,700	23·0	80,700	17·0	45,600	15·0	35,300	12·5	23,250	11·0	16,800	23
23·0	80,700	23·0	80,700	16·0	40,400	15·0	35,300	12·0	21,000	10·0	12,800	24
23·5	83,850	24·0	87,000	15·5	37,850	15·0	35,300	12·0	21,000	10·0	12,800	25
23·5	83,850	24·0	87,000	15·0	35,300	15·0	35,300	11·5	18,900	10·0	12,800	26
23·0	80,700	24·0	87,000	15·0	35,300	14·5	32,800	11·0	16,800	10·0	12,800	27
23·0	80,700	24·0	87,000	15·0	35,300	14·0	30,300	11·0	16,800	10·0	12,800	28
22·0	74,500	23·0	80,700	15·0	35,300	14·0	30,300	10·5	14,800		12,800	29
21·5	71,500	21·0	68,500	14·5	32,800	13·5	27,900		13,800		12,800	30
21·0	68,500	20·0	62,500			13·0	25,500				12,800	31

MONTHLY DISCHARGE of Fraser River, at Lytton, above mouth of Thompson, for 1912.

(Drainage area, 63,000 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
March	12,800	7,800	9,755	0·15	0·17	600,000
April	51,200	10,800	30,763	0·49	0·55	1,830,000
May	159,250	51,200	99,563	1·6	1·8	6,120,000
June	173,000	80,700	122,197	1·9	2·1	7,270,000
July	133,500	68,500	88,923	1·4	1·6	5,460,000
August	87,000	62,500	78,777	1·2	1·4	4,840,000
September	56,800	32,800	44,608	0·71	0·79	2,654,000
October	51,200	25,500	36,934	0·59	0·68	2,270,000
November	25,500	13,800	21,598	0·34	0·38	1,285,000
December	21,000	12,800	14,955	0·24	0·28	920,000

NOTE.—The river is open all the year.
Accuracy, "B".

GILLEY CREEK (112).

Gilley (also called Munroe) creek has its source in Dennett and Gilley lakes at an elevation of 2,000 feet. The mountains around it rise to an altitude of 3,000 feet to 4,000 feet. It discharges into Pitt river, practically at sea-level. The stream is only one mile in length between Gilley lake and Pitt river, and is a series of water falls and rapids; its drainage area is about 8 square miles. It is open all year round, and the annual precipitation is about 80 inches.

Gilley Bros., Ltd., have a small industrial development (to obtain power for quarrying) on Gilley creek. A dam has been constructed on Gilley lake, which affords excellent facilities for storage. Some storage may also be obtained on Dennett lake. Gilley creek water will no doubt be used at some time for a large development, since a head of 2,000 feet may be obtained in the short distance of one mile.

The station was established on November 10, 1911, by C. G. Cline and K. H. Smith; weekly gauge readings were taken continuously to the end of December, 1912. It is located above Gilley Bros'. power intake, and measurements are made by wading. The gauge is a standard vertical staff gauge, 5 feet long, and is nailed to a stump about 50 yards above the intake. The bed of the stream is rocky, and overflow might occur, were it not that the freshet water is controlled by the dam on Gilley lake.

DISCHARGE MEASUREMENTS of Gilley Creek, above Quarry Intake, 1911-12.

Date.	Hydrographer.	Meter No.	Width	Area of section.	Mean velocity.	Gauge height.	Discharge.
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
1911.							
Nov. 10	C. G. Cline, K. H. Smith	1,053	3·0	3·1	1·8	1·1	5·6
1912.							
Sept. 4	C. G. Cline.	1,046	6·5	6·1	1·5	1·29	9·1
Nov. 4	"	1,046	6·0	6·5	1·6	1·4	10·4

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DAILY GAUGE HEIGHT AND DISCHARGE of Gilley Creek, above Quarry Intake, for 1911.

Day.	November.		December.	
	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		5·8		9·3
2		5·8		9·7
3		5·8		10·1
4		5·8	1·4	10·5
5		5·8		10·4
6		5·8		10·2
7		5·8		10·0
8		5·8		9·8
9		5·8		9·6
10	1·1	5·8		9·4
11		7·8		9·2
12		9·8		9·0
13		11·8		8·9
14		13·8		8·8
15		15·5	1·3	8·7
16	1·7	17·1		8·4
17		16·0		8·2
18		15·0		8·0
19		14·0		7·8
20		13·0		7·6
21		12·0		7·4
22		10·5	1·2	7·1
23		8·0		6·8
24	1·2	7·1		6·4
25		7·4		6·0
26		7·7		5·6
27		8·0		5·2
28		8·3		4·8
29		8·6		4·4
30		8·9		4·0
31				3·6

MONTHLY DISCHARGE of Gilley Creek, above Quarry Intake, for 1911.

(Drainage area, 8 square miles.)

Month.	Discharge in second-feet.				Run Off.		Rainfall.
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
November	17·1	5·8	9·3	1·2	1·3	553	
December	10·5	3·6	7·9	0·99	1·1	486	
The period							80

NOTE.—Accuracy, "B."

Daily Gauge Height and Discharge of

Day.	January.		February.		March.		April.		May.		June.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	3·3	.....	19·4	.....	7·8	.....	11·6	.....	23·2	1·8	19·4
2	.....	3·0	1·8	19·4	.....	6·6	.....	11·8	.....	22·4	.....	17·9
3	0·8	2·7	.....	20·1	.....	5·9	.....	12·0	.....	21·6	.....	16·4
4	.....	3·6	.....	20·0	.....	5·5	.....	12·2	.....	20·7	.....	14·9
5	.....	4·5	.....	20·4	.....	5·0	.....	12·4	.....	19·8	.....	13·4
6	.....	5·4	.....	20·8	1·0	4·6	1·5	12·6	.....	18·9	.....	11·9
7	.....	6·3	.....	21·1	.....	4·8	.....	12·8	.....	18·0	.....	10·4
8	.....	7·2	.....	21·4	.....	5·0	.....	13·0	1·7	17·1	.....	8·9
9	.....	8·0	1·9	21·7	.....	5·2	.....	13·2	.....	17·1	.....	7·4
10	.....	8·8	.....	21·0	.....	5·4	.....	13·4	.....	17·1	1·1	5·8
11	.....	9·6	.....	19·3	.....	5·6	.....	13·6	.....	17·1	.....	6·0
12	1·4	10·5	.....	18·7	.....	5·7	.....	13·8	.....	17·1	.....	6·2
13	.....	11·0	.....	18·1	1·1	5·8	.....	14·0	.....	17·1	.....	6·5
14	.....	11·5	.....	17·8	.....	6·0	.....	14·2	1·7	17·1	.....	6·8
15	.....	12·0	.....	17·5	.....	6·2	.....	14·4	.....	17·1	1·2	7·1
16	.....	12·5	1·7	17·1	.....	6·4	.....	14·6	.....	17·1	.....	7·1
17	.....	13·0	.....	16·4	.....	6·6	1·6	14·8	.....	17·1	.....	7·1
18	.....	13·6	.....	15·7	.....	6·8	.....	14·8	.....	17·1	.....	7·1
19	.....	14·2	.....	15·0	.....	7·0	.....	14·8	.....	17·1	.....	7·1
20	1·6	14·8	.....	14·3	1·2	7·1	.....	14·8	.....	17·1	.....	7·1
21	.....	15·7	.....	13·6	.....	7·5	.....	14·8	.....	17·1	.....	7·1
22	.....	16·6	.....	12·9	.....	8·0	.....	14·8	1·7	17·1	.....	7·1
23	.....	17·5	.....	12·3	.....	8·5	1·6	14·8	.....	17·4	.....	7·1
24	.....	18·4	.....	11·7	.....	9·0	.....	16·1	.....	17·7	1·2	7·1
25	1·8	19·4	.....	11·1	.....	9·5	.....	17·4	.....	18·0	.....	6·6
26	.....	19·4	1·4	10·5	.....	10·0	.....	18·7	.....	18·3	.....	6·0
27	.....	19·4	.....	10·0	1·4	10·5	.....	20·0	.....	18·6	.....	5·4
28	.....	19·4	.....	9·5	.....	10·8	.....	21·3	.....	18·8	.....	4·8
29	.....	19·4	.....	9·5	.....	11·0	.....	22·7	.....	19·0	.....	4·2
30	.....	19·4	.....	.....	.....	11·2	2·0	24·0	.....	19·2	.....	3·6
31	.....	19·4	.....	.....	.....	11·4	.....	.....	.....	19·3	.....	.....

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Gilley Creek, above Quarry Intake, for 1912.

July.		August.		September.		October.		November.		December.		Day.
Gauge. height.	Dis- charge.	Gauge height.	Dis- charge	Gauge height.	Dis- Charge	Gauge height.	Dis- charge	Gauge height.	Dis- charge	Gauge height.	Dis- charge	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
.	3·0		0·5		7·8	1·4	10·5		10·2		8·7	1
.	2·4		0·5		8·1		10·0		10·3		8·7	2
.	1·8		0·5	.....	8·3		9·5		10·4		8·7	3
0.6	1·2		0·5	1·29	8·5		9·0	1·4	10·5		8·7	4
.	1·2	.....	0·5	.	8·6		8·5		11·0		8·7	5
.	1·2	0·5	0·5	1·3	8·7		8·0		11·5		8·7	6
.	1·2	.	0·6		8·6		7·5		12·0	1·3	8·7	7
.	1·2		0·7		8·4	1·2	7·1		12·5		9·0	8
.	1·2		0·8	.	8·2		7·1		13·0		9·3	9
.	1·2		0·9	.	8·0		7·1		13·5		9·6	10
.	1·2		1·0		7·8		7·1		14·0		9·9	11
.	1·2		1·0		7·6		7·1		14·5		10·2	12
0·6	1·2	.....	1·1		7·5		7·1		15·0	1·4	10·5	13
.	1·2	0·6	1·2		7·4	1·2	7·1		15·5		10·2	14
.	1·2		1·3		7·3		7·2		16·0		10·0	15
.	1·2		1·4	1·2	7·1		7·4		16·5		9·8	16
.	1·2		1·5		7·0		7·6		17·0		9·6	17
.	1·2		1·6		6·8		7·8		17·5		9·4	18
.	1·2		1·7		6·6		8·0		18·0		9·2	19
0·6	1·2		1·8		6·4		8·2		18·5		9·0	20
.	1·0	0·7	1·9		6·2		8·4		19·0		8·7	21
.	0·9		2·8		6·1		8·6		19·2		8·4	22
.	0·8		3·7		6·0		8·8	1·8	19·4		8·1	23
.	8·7		4·6		5·9		9·0		18·0		7·8	24
.	0·6	.	5·0	1·1	5·8		9·2		16·5		7·5	25
0·5	0·5		5·4		6·4		9·4		15·0	1·2	7·1	26
.	0·5		5·8		7·0		9·6		13·4		7·1	27
.	0·5		6·2		7·7		9·8		11·8		7·1	28
.	0·5		6·6		8·4		9·9		10·2		7·1	29
.	0·5	1·2	7·1	. .	9·4		10·0	1·3	8·7		7·1	30
.	0·5		7·5		. .		10·1		. . . .		7·1	31

MONTHLY DISCHARGE of Gilley Creek, above Quarry Intake, for 1912.

(Drainage area, 8 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
January	19·4	2·7	12	1·5	1·7	738	
February	21·7	9·5	16	2·0	2·2	920	
March	11·4	4·6	7·3	0·91	1·0	449	
April	24·0	11·6	15·1	1·9	2·1	898	
May	23·2	17·1	18·3	2·3	2·65	1,130	
June	19·4	3·6	8·4	1·0	1·1	500	
July	3·0	0·5	1·4	0·18	0·21	86	
August	7·5	0·5	2·5	0·31	0·36	154	
September	9·4	5·8	7·4	0·9	1·0	440	
October	10·5	7·1	8·4	1·0	1·1	516	
November	14·3	1·8	14·3	1·8	2·0	851	
December	10·5	7·1	8·7	1·1	1·3	535	
The year	24·0	0·5	9·9	1·2	16·7	7,220	80

NOTE.—These results are obtained from three measurements only.
Accuracy, "C."

GOLD CREEK (122).

Gold creek is a small tributary of Coquitlam river from the east, about 2 miles below the outlet of Coquitlam lake.

The flow of this station is of importance on account of the riparian and other rights on lower Coquitlam river, which are liable to be affected by the damming of Coquitlam river at the lake, and the diversion of the water to lake Buntzen.

A regular hydrographic station was established on Gold creek on October 25, 1912, by C. G. Cline. The gauge is located about one-quarter mile from the mouth. It is a vertical staff gauge fastened to the stump of a 4-inch alder tree on the right bank of the stream. The datum of the gauge is referred to three bench-marks.

The measuring section is about 100 feet above the gauge.

Gold creek is a rapid mountain stream, about 30 to 40 feet wide and, at high water, about 3 feet deep. On October 26, 1912, the discharge was 124 c.f.s., with a mean velocity of 2·6 feet per second.

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The following float measurements during 1910, 1911 and 1912, were taken by Mr. R. S. Stronach, departmental resident engineer at Coquitlam dam:—

GOLD CREEK.

Date.	Discharge	Date.	Discharge	Date.	Discharge
1910.	c. f. s.	1911.	c. f. s.	1911.	c. f. s.
July 26	30	January 24	13	October 16	76
July 29	28	January 27	12	October 21	27
August 2	20	January 31	17	October 26	26
August 5	18				
August 9	17	February 10	17	November 1	21
August 12	16	February 14	12	November 7	53
August 16	14	February 17	14		91
August 19	14	February 19	12	December 19	183
August 23	16	February 22	10	December 22	42
August 26	15	February 26	8	December 28	
August 30	16				
		March 5	15	1912	
September 1	16	March 10	35		32
September 6	16	March 13	83	January 2	19
September 9	14	March 19	22	January 10	41
September 13	12	March 25	42	January 16	37
September 16	10	March 28	27	January 26	130
September 20	8	March 31	23	January 29	
September 23	7				42
September 30	37	April 4	20	February 4	49
		April 11	30	February 16	19
October 3	73	April 19	23	February 23	
October 4	72	April 25	34		17
October 6	102	April 28	28	March 1	16
October 8	98			March 10	13
October 10	47	May 4	107	March 16	15
October 18	54	May 9	102	March 22	21
October 25	49	May 16	87	March 28	
October 29	38	May 21	31		18
		May 27	29	April 7	19
November 1	45			April 20	
November 4	42	June 1	23		75
November 7	147	June 6	20	May 4	33
November 10	149	June 12	17	May 13	24
November 12	110	June 16	22	May 18	
November 16	47	June 20	17		19
November 21	210	June 27	23	June 3	
November 22	175				23
November 26	47	July 7	22	July 10	17
November 29	27	July 26	15	July 16	15
				July 22	16
December 2	32	August 1	14	July 24	14
December 6	157	August 5	12	July 30	
December 8	127	August 11	13		23
December 10	47	August 14	12	August 12	24
December 12	29	August 25	10	August 17	17
December 16	31	August 29	6	August 25	
December 23	93	August 31	5		27
December 27	43			September 11	21
December 30	60	September 4	4	September 13	15
		September 10	5	September 27	
1911		September 13	42		18
		September 17	23	October 4	21
January 8	37			October 9	17
January 11	26	October 6	15	October 11	97
January 20	17	October 10	18	October 20	

Gordon Creek (266).

Gordon creek is called Dairy creek on the Dominion Government maps. It is a small irrigation stream, about 4 miles long, flowing into North Thompson river from the west, some 13 miles from Kamloops. The creek is about 3 feet wide, and only a few inches deep. All the water is used for irrigation.

On June 21, 1911, the discharge was only 0·4 c.f.s., and during July and August the creek was dry.

In 1912, the maximum discharge occurred on May 17, and was about 7 c.f.s., lasting only for the one day. On May 24 it had decreased to 2·5 c.f.s. During June the mean flow was 1 c.f.s., and in July only 0·5 c.f.s.

See miscellaneous measurements of Gordon creek in list of miscellaneous discharge measurements.

Greenstone Creek (261).

Greenstone creek has its source in Big Fish lake township 18, range 20, west 6th meridian, at an elevation of 4,820 feet, and discharges into Meadow creek, 8 miles from the mouth, at an elevation of 4,000 feet. It is part of the Guichon-Nicola-Thompson drainage; the drainage area, as measured from the Geological Survey map, dated 1895, scale 2 miles to an inch, is 20 square miles. This is a contentious irrigation stream in the Dry Belt; the summers are hot and dry, the winters long and very cold (–30 F.); the mean annual precipitation is about 15 inches.

Greenstone creek is about 6 miles long, and drains Face and Big Fish lakes. There is no agricultural land except the Watson meadows at the mouth; there is a record of 1,000 inches appurtenant to this land. In addition, the British Columbia Fruitlands Co. and the Beaton Estate have records of 500 inches each to divert water from Face lake and Big Fish lake, respectively, into the Thompson drainage; while the mean run-off of the creek during the irrigation season of 1912 (an exceptionally wet season) was less than 10 second feet or 350 inches. The British Columbia Fruitlands Co. propose to turn the water from Face lake into the head-waters of Cherry creek, and thence via Cherry creek to their estates. The Beaton estate proposes to build an earthen ditch 22 miles long in a northwesterly direction to its ranch in the Cherry Creek valley; the ditch would receive water from Duffy, Chartrand and Three-mile creeks, en route, provided the application for water for these estates were granted. The combined area of Big Fish and Face lakes is approximately 500 acres, and the lakes could be dammed to a height of 15 feet; but as the drainage area of the two lakes is only 20 square miles, it seems improbable that there will be enough water to make the schemes practicable from a commercial standpoint. Both of these schemes are meeting with strenuous opposition from the interests on Guichon creek, especially Lower Nicola.

The river station was established September 14, 1911, by W. M. Carlyle. The measuring section is located about one-half mile from the mouth. A standard vertical staff gauge is located on the left bank at the measuring section. All the measurements are made by wading, though in high water, measurements have to be made at the Chartrand-Trout lake road, where the water runs in two channels. The measuring section is only fair, as part of the creek apparently sinks, reappearing below the measuring section. The control, however, is good, the current uniform, the channel permanent, and the banks not liable to overflow, unless the channel were blocked by logs which are abundant.

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DISCHARGE MEASUREMENTS of Greenstone Creek, one-half mile above mouth, 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
April 30	H. J. E. Keys	1057	13·	5·5	0·85	0·70	4·70
May 15	"	1057	37·	3·0	2·70	2·10	81·7
May 23	"	1057	29·	17·	2·0	1·15	34·6
June 3	"	1057	9·	5·15	2·5	0·78	12·9*
June 8	"	1057	8·5	3·90	2·0	0·68	7·8
July 15	"	1057	6·5	3·20	0·9	0·55	2·9
Sept. 13	"	1057	4·0	0·80	1·0	0·45	0·8

*New measuring section.

GAUGE HEIGHTS AND DAILY DISCHARGE of Greenstone Creek, one-half mile above mouth, for 1912.

Day.	May.		June.		July.		August.		September.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		8·0		9·7		3·6	0·5	1·7		
2	0·8	12·0		7·1		3·7				
3		16·0	0·6	4·5		3·7				
4		20·0		5·0		3·8				
5	1·0	23·0		5·5		3·9				
6		47·0		6·0		5·9				
7		59·0		6·5		4·0				
8		77·0	0·68	7·3		4·1				
9	2·2	95·0		6·5		4·1				
10		82·0		6·0		4·2				
11	1·8	69·0		5·5		4·3				
12		74·0		5·0		4·3				
13		79·0	0·6	4·5		4·4			0·45	0·85
14		84·0		5·1	0·6	4·5				
15	2·1	88·0		5·7	0·55	3·1				
16		76·0	0·65	6·2		2·4				
17		64·0		5·8	0·5	1·7				
18		52·0		5·4		1·2				
19	1·3	39·0		5·0	0·45	0·8				
20		36·0		4·6		1·2				
21		33·0		4·2	0·5	1·7				
22	1·15	30·5		3·8		1·7				
23		29·7		3·4		1·7				
24		28·9	0·55	3·1	0·5	1·7				
25	1·1	28·0		3·2		1·7				
26		25·4		3·3	0·5	1·7				
27		22·8		3·3		1·7				
28		20·2		3·4		1·7				
29	0·9	17·5		3·5	0·5	1·7				
30		14·9		3·5		1·7				
31		12·3			0·5	1·7				

MONTHLY DISCHARGE of Greenstone Creek, one-half mile above the mouth, for 1912. (Drainage area, 20 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	95	8	44	2·2	2·54	2,700	
June	9·7	3·1	5	0·25	0·28	297	
July	4·5	0·8	2·8	0·14	0·16	172	
The period							15

NOTE.—In 1911 the maximum flow of Greenstone creek was only about 15 c.f.s., about the middle of May. By the middle of June it had decreased to 3 c.f.s. and in July and August, it was zero.
Accuracy, "A" and "C."

GUICHON CREEK (213 AND 214).

Guichon creek is also called Ten-mile creek, Mamette creek, Na-a-a creek, Kazoom, Kanaix, Broom creek, Big creek. It empties into Nicola river from the north, about 35 miles east of Spence's Bridge. It has three main tributaries. These are, reckoning from the north:—

1. Main Guichon creek, flowing almost due south from about the center of township 19, range 22, west of 6th meridian (elevation 4,000 feet) for a distance of 12 miles. In section 4, township 18-21-6, it is joined by Witch creek.

2. Witch Creek enters main Guichon creek from the west; it is about 10 miles long, its main source being Divide lake in section 1, township 18-23-6 (elevation 3,960 feet). There is very little farm land up Witch creek except hay meadows, no permanent settlers, and particularly no irrigation. (See discharges of Witch creek for 1912.)

3. Meadow creek is the largest of the three tributaries. It forms into the main creek from the east in section 27, township 17-21-6, about three miles south of Witch creek. Meadow creek is some 15 miles long, and flows partly through a series of meadows lined with willow. It has several tributaries of its own, the principal one being Greenstone creek, which is the outlet of Big Fish and Face lakes (elevation 4,800 feet). There are also small streams entering Meadow creek from Trout lake and Ridge lake. (See discharges of Meadow creek for 1911 and 1912.)

Nearly half a mile south of the mouth of Meadow creek is the south limit of the Railway Belt, and three miles farther south Guichon creek flows into Mamit lake. This lake is about 2 miles long and in some places nearly one-half mile wide (elevation 3,270 feet). Leaving Mamit lake, Guichon creek flows due south for 15 miles and empties into Nicola river.

Numerous small streams enter Guichon creek throughout its length, such as Chartrand, Quenville, Ray, and Eight-mile creeks. These are used for irrigation, but they dry up in the summer just when the water is badly needed.

Guichon valley is, in general, very narrow with sloping benches rising on each side from 200 feet to 1,000 feet above the creek. These benches, particularly on the east side, are suited only for grazing, being too dry for farming, and there is insufficient available water for irrigation. On account of their height above Guichon creek the waters of that stream cannot be applied. The timber is rather scattered, even near the

head-waters, where the land is used for summer ranges. On the west side, especially from Mamit lake down, the timber is more dense, but is not of a merchantable size.

The valley proper is very narrow, with little farming land. In about seven or eight places in the thirty miles of its length it broadens to nearly half a mile in width. These wider bottom lands, with adjoining gently sloping lands, constitute the ranches of the Guichon valley. Owing to the high altitude (about 30,000 feet) they are ranching rather than farming lands, hay being the principal crop, although some vegetables are also grown, and a little mixed farming attempted. Early frosts are prevalent. Even if abundant crops could be produced on the scattered farms the distance from markets preclude the possibility of the district ever becoming important except as a ranching district.

A good wagon road from Savona to Nicola valley runs along the east side of Guichon creek.

At the mouth of Guichon creek, however, the situation changes somewhat. The valley widens, and where it joins the Nicola valley there is a tract of some 1,600 acres of very good irrigable farm land, in addition to the large Naik Indian Reserve. This is called the Lower Nicola district. The land may be irrigated from Guichon creek, although with a little expense almost 50 per cent could be irrigated from Nicola river. By irrigation, hay and vegetables are grown, with a little fruit and grain. The development has not been very extensive, only 550 acres being as yet under cultivation. Although some of the ten or eleven farms are well run, the district does not give evidence of great enterprise, particularly in the irrigation methods followed.

The Nicola valley branch line of the C.P.R. runs through these Lower Nicola lands.

The drainage area of Guichon creek is about 475 square miles, being divided as follows:—

	Square Miles.
Main Guichon creek above Witch creek. (Elevation ranging from 3,300 feet to 5,000 feet)	73
Witch creek. (Elevation ranging from 3,300 feet to 5,000 feet)	41
Meadow creek. (Elevation ranging from 3,300 feet to 5,500 feet)	145
Chartrand creek. (Elevation ranging from 3,300 feet to 4,500 feet)	25
Quenville creek. (Elevation ranging from 3,300 feet to 4,000 feet)	7
Rey creek. (Elevation ranging from 3,270 feet to 5,000 feet)	24
Eight-mile creek. (Elevation ranging from 2,500 feet to 5,500 feet)	30
Other small tributaries, and catchment basin, Guichon Creek proper. (Elevation ranging from 1,800 to 5,000 feet)	130
Total drainage area	475

The rainfall varies according to the elevation, ranging from 12 inches at the mouth of the Guichon to 15 inches in the higher altitudes of the catchment basin. The snowfall also varies from 12 inches in the Nicola valley to 4 feet in the hills. There have been as yet no studies or investigations of the precipitation, evaporation, seepage, run-off, etc., in British Columbia, and only rough estimations can be made of these important data.

A number of gauging stations for determining the discharge of Guichon creek and its tributaries were established during 1911 and 1912 by the Hydrographic Survey, and measurements were made at different stages. See discharges, etc., at the following

stations: Guichon creek (above Mamit lake), Guichon creek (at mouth), Witch creek, Meadow creek, Greenstone creek, Leighton's ditch, and Quenville creek.

During the latter part of March the winter's snow begins to melt, gradually increasing until the maximum flood stage is reached about the middle of May. After this date the flow decreases until September 1, the discharge during July and August being insufficient for irrigation needs. The maximum discharge at the May flood is from twenty-five to forty times the minimum discharge in August. The fall rains produce a slight increase in the flow, only to recede again as winter sets in, the winter minimum being reached in February.

The natural reservoir for storing the waters of Guichon creek is Mamit lake. This lake is about two miles long, and in some places nearly one-half a mile wide. It has a superficial area of over 400 acres. The water level between high and low water varies about 4 feet. By damming the outlet of Mamit lake, and raising the level to a height of one foot above ordinary high-water mark, and in addition lowering the outlet 1 foot, 6 feet of water could be easily stored in this reservoir. There is more than enough water flowing in Guichon creek from April 1 to August 1 to fill this reservoir, even neglecting the fall and winter flow. This stored water need not be called upon until July, the normal flow being sufficient for the first irrigation. A great deal of water of Guichon creek is lost by seepage between Mamit lake and Lower Nicola, a distance of 15 miles, even though the carrying ditch is the well-defined bed of the creek.

The necessary storage works on Mamit lake would be a timber-cribbed, earth-filled dam, 60 feet long and 10 feet high, at the southerly end of the lake. This construction would be comparatively easy and cheap, all the materials being at hand. Lowering the outlet 1 foot would necessitate clearing the bed for a distance of 400 feet. If the irrigators co-operated in this work during the slack fall season, when the water is low, the cost of construction would be very small. At a somewhat greater expense, the storage capacity of Mamit lake could be considerably increased beyond the above estimate.

The impounding of waters in Mamit lake in this way would mean the flooding of some 55 acres of bottom lands, owned by Quenville (at the north end) and Laycock (at the southeast end). These lands produce a wild hay or grass, and during ordinary years are flooded for the greater part of the season, only one crop being obtained each year.

In Guichon creek, as in most streams of the Dry Belt, storage is the solution to the irrigation troubles due to the scarcity of water during the summer months.

WATER RECORDS ON GUICHON CREEK.

The provincial water records on Guichon creek (both within and outside the Railway Belt) may be divided into three divisions: (1) Lower Nicola, (2) lands along upper Guichon creek and its tributaries, (3) diversion records into other watersheds.

(1) Lower Nicola Records and Appurtenant Lands.

Present Owner.	Original Licensee.	Date of Record.	Amount of Water.	Description of Land.	Irrigable	Irrigated at present.
			Miner's inches.		Acres.	Acres.
Wm. Smith	E. Suchell	1873	300	L 131	200	35
A. G. Collett	T. Schwartz	1878	300	L. 129	300	200
	T. Schwartz	1885	300	L. 129		
D. Dodding	D. Dodding	1904	100	L. 132	120	80
R. Whitaker	F. D. Woodward	1904	100		175	40
Jas. Smith	Jas. Smith	1904	100	L. 164	200	20
L. Austin	H. M. Woodward	1906	200	L. 134	100	35
				L. 135		
B. Bonthrone	B. Bonthrone	1906	100	L. 133	250	75
H. Stumbles	H. Stumbles	1906	100	L. 1612	135	
H. Lindley	H. Lindley	1906	100	L. 160	110	60
Maj. Fleck.						
John Smith	S. J. Woodward	1909	100	L. 1638	40	10
A. Sims	A. Sims	1906	100	(No longer in district)		
			1900		1,630	555

The amount of water recorded is far in excess of the future needs of the district. For the total irrigable area of 1,630 acres, 900 miner's inches (or 25 second-feet flowing for 100 days of the irrigating season) is sufficient. Besides, fully 700 acres of the Lower Nicola district can be irrigated from Nicola river. At present, only some 550 acres are under cultivation, and although the ranchers all declare that they will have many more acres cleared and in crop in a very few years, the prospects of such development do not look assuring.

The Naik (or Nicola-Mamette) Indian Reserve, situated at the mouth of Guichon creek, comprises 11,000 acres. Of this, about 1,500 acres are irrigable from Guichon creek and Nicola river. A record of 300 miner's inches from Guichon creek was allotted to this reserve in 1878. The present and future irrigation needs of this reserve should certainly be protected. If this reserve should ever pass into the hands of whites, or the Indians be assisted in up-to-date irrigation methods, the water requirements would be in excess of the present rights, but it is questionable if the present development of other lands should be retarded for the sake of that remote possibility.

(2) Records of Lands on Upper Guichon Creek and its Tributaries.

(*a*) There are several records on Eight-mile creek, but only a small quantity of water yet used. At present it does not affect Lower Nicola. The possibilities of the scattered irrigable parcels of land up Eight-mile creek are very limited. (Wholly outside the Railway Belt).

(*b*) J. Murray has a record for a small stream just north of Eight-mile creek. Of little or no importance to Guichon creek. He cannot irrigate from Guichon creek proper.

(*c*) John Marquart has a record for 200 inches (dated 1891) from the same small stream as Murray. Same remarks apply as to Murray. (Wholly outside the Railway Belt.)

(*d*) C. A. Sapondowski's land is on Guichon creek, 5 miles north of Eight-mile creek. He holds no records, but uses a small creek called McIlvoy creek for domestic

purposes. He could irrigate 40 acres from Guichon creek. (Wholly outside the Railway Belt.)

(*e*) J. C. Bampfield is the present owner of the old Rey place, at the southerly end of Mamit lake. For this land he holds a record for 500 inches from Rey creek (dated 1894). By storing the waters of Rey creek in a lake up that stream, sufficient could be obtained for the whole ranch. J. P. Phelps has a place up Rey creek, and holds a recent record for 1 second-foot (1910). His supply is dependent upon the needs of Bampfield. It is also reported that water is being diverted from the headwaters of Rey creek into Clapperton creek watershed. (Wholly outside of the Railway Belt.)

(*f*) J. Laycock, on the east shore of Mamit lake, has a record for 1 second-foot 1910) from a small tributary of Guichon creek. Very little importance. Bampfield holds a record for the Rey ranch from a small stream that may be the same as Laycock's stream. Mr. Laycock desires a record from Meadow creek. Laycock's land is outside the Railway Belt.

(*g*) L. Quenville owns 700 acres of irrigable land extending from Mamit lake to the south limit of the Railway Belt. He holds a record from Quenville creek for 300 inches (dated 1890). There is not enough water in Quenville creek for his needs during July and August, although some effort could be made to store the spring flood. Mr. Quenville wants a record from Meadow creek.

(*h*) A record of 50 inches was allotted from Meadow creek in 1878 to Pipseul, I.R., at the mouth of that stream (also called Pipseul creek). Only a few acres of the reserve are being irrigated (for hay). Inside the Railway Belt.

(*i*) A. Chartrand owns a good ranch with 200 acres of irigable land on Guichon creek at the mouth of Witch creek. He holds no record, but uses a little water for irrigation from both Witch creek and Chartrand creek. (Within the Railway Belt.) He desires a record from these streams.

(*j*) J. Latremouille owns lot 781 (Proteau place) on Guichon creek in township 18-21-6. He holds no records, uses a little water from Guichon creek. Rather a poor ranch. Within the Railway Belt.

(*k*) Fransi Allen owns a homestead in section 30, township 18-21-6. He has a record for 200 inches from Guichon (dated 1891). He is affected by the Leighton diversion from Guichon creek, and his rights should be protected. Within the Railway Belt.

(*l*) D. Cousineau has a homestead in northwest corner of township 17-20-6, on Meadow creek. He holds no records. Uses water from a small stream flowing through his farm. He has applied for a record of 100 inches from Greenstone creek.

(*m*) Neil Beaton owns the Watson Meadows or Meadow creek, at the mouth of Greenstone creek. He holds a record for 1,000 inches from Greenstone creek (Young's creek) recorded by Randall Young in 1889. Only a few acres have been irrigated under this record, and now Mr. Beaton wishes to transfer the record to land owned by him in Thompson valley. This record should be reduced to a minimum quantity, and certainly the transfer should not be allowed. Within the Railway Belt. See also Mr. Beaton's diversion record from the same source of supply (Big Fish lake).

(*3*) *Diversion Records from Guichon Drainage Area.*

(1) Barnes record (now held by Ellen Benjamin), dated July 17, 1880, for 1,000 inches to be diverted from Guichon creek and taken in a northwesterly direction down Barnes creek to lot 1, group 4, near Ashcroft. It has never been used, and should be cancelled for non-use and impracticability.

(2) Pennie's record (now held by British Columbia Horticultural estates, Wal-

hachin), dated 1884, for 300 inches to be diverted from Guichon creek to Pennie's ranch near Walhachin. It has never been operated, and should be cancelled.

(3) Beaton record (recorded and held by Neil Beaton), dated October 28, 1904, for 500 inches from Big Fish lake (in township 18-20-6) to be diverted for a distance of 22 miles to certain lands in Thompson valley. Not yet operated.

(4) Roper record (now held by British Columbia Fruitlands Co.), dated May 15, 1906, for 500 inches from Face lake (in township 18-20-6) to be diverted via Big Fish lake in a manner similar to the Beaton diversion.

Although Big Fish and Face lakes are of a good size, I greatly doubt that sufficient water can be obtained from them to fulfil the Beaton and Roper records for 1,000 inches. The drainage area of these lakes is very small (about 20 square miles). The construction of the diversion works for these records would be a very expensive undertaking. No work beyond preliminary investigations has yet been done. These records should not be ratified without serious investigation and reflection. *See* the discharges of Greenstone creek for 1912.

(5) J. B. Leighton record, dated June 30, 1906, to divert 100 inches from Guichon creek into Tunkwa (or Big) lake, thence by natural channel of west branch of Three-mile creek to section 25, 35, and 36, township 20-21-6.

(6) R. F. Leighton record, dated June 10, 1908, to divert 100 inches from Guichon creek, during the spring freshet and in the fall when not required for irrigation, into Tunkwa (or Big) lake, thence into Leighton lake, thence down Three-mile creek to land in section 1 and 2, township 21-21-6. This record is in operation in conjunction with J. B. Leighton's.

(7) A. H. Cotton record, dated June 10, 1908, is the same or similar to R. F. Leighton record, the land appurtenant being section 1, township 21-21-6. Mr. Cotton has since abandoned his homestead, and this record should be cancelled.

Two years ago, Mr. J. B. Leighton, of Savona, with his three sons, Charles, Leslie, and R. F., acting by right of the two provincial water records, constructed a small dam across main Guichon creek at a point near east boundary of section 7, township 19-21-6, some 7 miles from the head of the creek, and by means of a ditch and flume 2½ miles long, with carrying capacity of about 30 second-feet, diverted water from Guichon creek into Tunkwa and Leighton lakes, where it was stored, and when required for irrigation, was carried down the west fork of Three-mile creek to the Leighton lands, four miles from Savona, near Kamloops lake. See miscellaneous measurements of Leighton's diversion ditch from Guichon creek.

The farmers of Lower Nicola at the mouth of Guichon creek have protested vigorously against this diversion, claiming that it greatly injured their lands, and interfered with their prior and natural rights.

In discussing the pros and cons of the Leighton diversion and the protest against it, I wish to first lay down a fundamental rule regarding the diversion of water from one watershed to another:

'The water in a drainage area is the birthright of that drainage area, and should not be diverted therefrom unless the supply is more than sufficient for the needs of the drainage area.'

This almost axiomatic rule has been at all times borne in mind in this dissertation of the Guichon diversion question.

After a careful study of the Guichon district, its irrigation needs, the available water supply, and the water rights situation, I beg to submit the following conclusions:—

(1) The water supply of the Guichon drainage area, if beneficially used and properly conserved, is more than sufficient for the present and future domestic and irrigation needs of the drainage area.

(2) The water of the Guichon drainage area at Lower Nicola and Guichon valley proper is not being beneficially used at the present time; a great amount of water is allowed to run to waste in the spring; the irrigation works, head-gates, ditches and flumes are not of the most approved construction for the beneficial use of water; and the water users have made no attempts to alleviate their own troubles by storing or conserving their water supply.

(3) Storage of the surplus waters of the spring floods can be conveniently and economically performed. The farmers of Lower Nicola, while admitting that the waters can be stored in Mamit lake, and that in this way a sufficient supply can be obtained for their needs, contend that it is unfair to ask them to undergo the trouble and expense of such storage constructions merely to give Mr. Leighton water, and they claim that Mr. Leighton, the Government, or some one should assist in the expense of the storage works.

(4) Fully 700 of the 1,600 irrigable acres in Lower Nicola have an alternative water supply in Nicola river, which can be called upon at an expense not at all prohibitive or unreasonable. The supply in Nicola river is unlimited, and some of the farmers are contemplating using this stream, and thereby making themselves independent of an unreliable supply.

(5) The claim of the farmers of Lower Nicola that their scarcity of water during the past two years (1910-11) has been due to the Leighton diversion cannot be wholly proven. While it may be true in a small degree, I believe that the scarcity has in a greater proportion been due to the extreme dryness of the seasons of 1910 and 1911, during which years the water supply in many districts of the Dry Belt was very low. The Leighton diversion taps only 24 square miles of the 475 square miles of the Guichon drainage area, and while the run-off per square mile in the vicinity of these upper 24 miles is greater than the average for the whole drainage area, yet the influence of the diversion is not as great as is claimed. On June 19, 1911, there was a discharge of only 4 second-feet in Guichon creek at the Leighton diversion, and at the same date 9 second-feet were running to waste at the mouth of Guichon creek.

Guichon Creek, Near Mouth (213).

This station was established on June 4, 1911, in order to determine the amount of waste water in Guichon creek not used by the farmers of Lower Nicola, who were protesting to the Dominion and Provincial Governments that they were suffering from water shortage due to the Leighton diversion of Upper Guichon creek water into Thompson River drainage. The station is located below all diversions, the gauge and measuring section being about 25 feet above the C.P.R. bridge across Guichon creek (Nicola Valley branch) and about 150 yards above the mouth of the creek as it flows into Nicola river.

The gauge is a standard staff gauge, 5 feet long. It is fastened to a large tree stump on the right bank, 25 feet above the bridge.

Three bench-marks were established to which the zero of the gauge was referred.

SESSIONAL PAPER No. 25f

DISCHARGE MEASUREMENTS of Guichon Creek, near mouth, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
1911							
June 4	W. M. Carlyle	1044	28	35·8	1·6	2·22	58·7
June 17	C. E. Richardson	1048	18	13·4	·7	1·37	9·1
June 19	"	1048	16	10·	·5	1·20	4·7
July 11	"	1048	2	·65	·6	·85	·41*
1912.							
May 3	"	1048	32	54·2	3·0	2·87	163·
May 23	C. G. Cline	1046	42	69·6	5·0	3·60	345
July 4	B. Corbould	1044	13	9·6	0·9	1·71	8·9
July 22	"	1044	13·5	13·4	1·5	1·85	20·0
Aug. 12	"	1044	13·	10·	0·9	1·7	9·2

*Different section.

DAILY GAUGE HEIGHT AND DISCHARGE of Guichon Creek, near mouth, for 1911.

Day.	June.		July.	
	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		61·5	0·9	1·0
2		61·5	0·85	0·6
3		61·5	0·85	0·6
4	2·25	61·5	0·85	0·6
5	2·2	56·5	0·85	0·6
6	2·2	56·5	0·85	0·6
7	2·15	52·0	0·75	0·2
8	2·05	43·3	0·75	0·2
9	1·95	35·3	0·75	0·2
10	1·88	30·5	0·75	0·2
11	1·85	28·6	0·85	0·6
12	1·8	25·6	0·75	0·2
13	1·7	20·5	0·9	1·0
14	1·62	17·2	0·95	1·5
15	1·5	12·7	0·9	1·0
16	1·4	9·6	0·85	0·6
17	1·35	8·3	0·85	0·6
18	1·3	7·0	0·85	0·6
19	1·15	4·1	0·85	0·6
20	1·10	3·3	0·85	0·6
21	1·05	2·6	0·85	0·6
22	1·02	2·2	0·85	0·6
23	1·0	2·0	0·8	0·3
24	1·0	2·0	0·8	0·3
25	1·0	2·0	0·75	0·2
26	1·0	2·0	0·75	0·2
27	1·0	2·0	0·75	0·2
28	0·9	1·0	0·7	0·0
29	0·9	1·0	0·7	0·0
30	0·95	1·5		
31				

MONTHLY DISCHARGE of Guichon Creek, near mouth, for 1911.

(Drainage area, 475 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAIN-FALL.
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage. area.	Total in acre-feet.	Inches.
June	61·5	1·0	22·.	0·05	0·06	1,340	
July	1·5	0·0	0·5	0·001	0·001	31	
The period							11

NOTE.—The station was established on June 4, after the maximum flood had passed. The stream at the station ran dry on July 28. The year 1911 was an exceedingly dry year in the Dry Belt.
Accuracy. "C."

SESSIONAL PAPER No. 25f

GAUGE HEIGHT AND DAILY DISCHARGE of Guichon Creek, near mouth, for 1912.

MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Day.
Gauge height	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
.....	168	2·5	96	1·7	9	1·8	16	.....	.....	1
.....	168	2·4	81	1·7	9	.....	20	1·8	16	2
2·9	168	2·3	67	1·7	9	1·9	24	.....	18	3
3·1	210	2·2	55	1·7	9	.....	22	1·85	20	4
3·3	260	2·1	43	1·8	16	1·85	20	.....	22	5
3·5	315	2·0	32	1·8	16	.....	18	1·9	24	6
3·8	420	2·0	32	1·8	16	1·8	16	.....	24	7
4·0	490	1·9	24	1·8	16	.....	12	1·9	24	8
4·1	530	1·9	24	1·9	24	1·7	9	.....	22	9
4·3	610	1·9	24	1·9	24	.....	10	1·85	20	10
4·4	650	1·9	24	2·0	32	1·72	10	.....	.....	11
4·5	695	1·9	24	2·1	43	.....	11	.....	.....	12
4·3	610	1·9	24	.....	45	1·75	12	.....	.....	13
4·2	570	1·9	24	2·1	43	.....	13	.....	.....	14
4·3	610	1·9	24	.....	38	1·78	15	.....	.....	15
4·4	650	1·9	24	2·0	32	.....	15	.....	.....	16
4·5	695	1·9	24	.....	32	1·8	16	.....	.....	17
4·3	610	1·9	24	2·0	32	.....	16	.....	.....	18
4·2	570	1·9	24	.....	32	1·8	16	.....	.....	19
4·0	490	1·9	24	2·0	32	.....	18	.....	.....	20
3·9	455	1·9	24	.....	26	1·85	20	.....	.....	21
3·8	420	1·8	16	1·85	20	.....	22	.....	.....	22
3·6	345	1·8	16	.....	22	1·9	24	.....	.....	23
3·5	315	1·8	16	1·9	24	.....	22	.....	.....	24
3·4	285	1·8	16	.....	24	1·85	20	.....	.....	25
3·2	235	1·7	9	1·9	24	.....	19	.....	.....	26
3·0	188	1·7	9	.....	24	1·82	18	.....	.....	27
2·9	168	1·7	9	1·9	24	.....	17	.....	.....	28
2·8	149	1·7	9	.....	22	1·8	16	.....	.....	29
2·7	131	1·7	9	1·85	20	.....	16	.....	.....	30
2·6	113	.....	.....	.....	18	1·8	16	.....	.....	31

MONTHLY DISCHARGE of Guichon Creek, near mouth, for 1912.

(Drainage area, 475 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	95	113	397	0·84	1·0	24,400	
June	96	9	28·4	0·06	0·07	1,690	
July	43	9	24·4	0·05	0·06	1,500	
August	24	9	16·7	0·035	0·04	1,030	
The period							12

NOTE.—Readings were commenced about May 1 and continued until September 10. The year 1912 was a wet year in the Dry Belt, and the supply of water for irrigation was good in almost every district It will be noted that there was water running to waste in Guichon creek all summer, even though the quantity diverted by Leighton was much greater than in 1911.

Accuracy, "B."

GUICHON CREEK, ABOVE MAMIT LAKE.

The station on Guichon creek above Mamit lake was established on June 3, 1911, by W. M. Carlyle. The measuring section is at a private bridge on Quenville's ranch, about a mile or so above Mamit lake. At high water in May, 1912, this section was flooded over the bridge, and high water measurements were taken at a bridge higher up stream (1 mile), and the discharge of Quenville creek measured and added.

The gauge is a vertical staff (cedar) graduated in feet and tenths with black paint. The gauge is fastened to right-hand upper side of bridge. Replaced by new enamelled iron gauge, 6 feet long, in 1912.

Measurements are made by a small Price electric current meter, suspended by cable; measurements being made from the bridge at high water. At low water, wading measurements with wading rod were made.

The initial point for soundings is at edge of the right bank at upper side of bridge.

The water is fairly swift. Velocity at high water, 1·5 to 2·0 feet per second. The channel above the station is straight for 25 feet. The channel below the station is straight for 50 feet. The right bank is clean, sandy, liable to overflow during excessive floods; about 4 feet high. The left bank is clean, about 4 feet high; liable to overflow during excessive floods.

Bed of the stream is sand and gravel; may shift a little, but not to seriously affect the gauge; one channel always; average depth, about 2 feet; at low water, 1 foot; at high water, 6 feet. There is a slight chance of backwater on lower side of the bridge, on account of brush and fence.

The following bench-marks were established:—

B.M. No. 1.—Elevation, 6·92 feet; nail driven horizontally in west side of fence post on left upper side of the bridge.

B.M. No. 2.—Elevation, 6·08 feet; nail driven vertically in abutment of lower side of bridge.

B.M. No. 3.—Elevation, 7·79 feet; nail driven horizontally in fourth fence post from left upper side of bridge.

(Elevations are referred to zero of gauge.)

SESSIONAL PAPER No. 25f

DISCHARGE MEASUREMENTS of Guichon Creek, above Mamit Lake, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
1911.							
June 3	W. M. Carlyle	1044	27	41·7	1·50	2·16	61·3
June 27	"	1044	16	10·1	0·73	0·96	7·4
July 18	"	1044	16	9·2	0·51	0·87	4·7
Aug. 2	"	1044	10	4·1	0·64	0·80	2·6
Aug. 9	"	1044	15	7·4	1·30	1·02	9·8
1912.							
Apr. 28	H. J. E. Keys	1057	21	27·4	1·84	1·95	50
May 11	"	1057	63	279	1·50	6·05	*420
May 22	"	1057	54	178	1·36	5·20	*260
June 1	"	1057	26	68·8	1·75	3·11	121
June 24	"	1057	22	20·8	1·07	1·41	22·4
June 9	"	1057	26	27·7	1·46	1·98	55·1
July 1	"	1057	26	19·2	1·13	1·30	21·6
July 13	"	1057	26	29·1	1·40	1·72	39·0
July 14	"	1057	26	29·3	1·30	1·62	39·0
July 29	"	1057	26	23·1	1·26	1·48	29·1
Aug. 15	"	1057	22	20·3	1·20	1·44	24·5
Aug. 31	"	1057	24	18·0	1·09	1·20	19·5
Sept. 14	"	1057	24	14·5	1·04	1·24	15·1
Sept. 24	"	1057	24	14·6	0·82	1·18	12·1

*Made at difierent section.

DAILY GAUGE HEIGHT AND DISCHARGE of

Day.	JUNE.		JULY.		AUGUST.	
	Gauge height.	Discharge	Gauge height	Discharge.	Gauge height.	Discharge.
	Feet	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·00	8·9	0·78	2·1
2			0·98	8·3	0·80	2·6
3	2·16	61·4	0·95	7·3	0·80	2·6
4	2·12	61·4	0·95	7·3	0·80	2·6
5	2·11	58·7	0·94	7·0	0·82	3·2
6	2·04	55·1	0·95	7·3	1·00	8·9
7	1·99	52·5	0·92	6·3	0·96	7·6
8	1·89	47·4	0·94	7·0	1·01	9·2
9	1·80	42·9	0·94	7·0	0·99	8·6
10	1·72	39·0	0·96	7·6	0 99	8·6
11	1·90	46·9	0·96	7·6	0·95	7·3
12	1·49	28·2	0·95	7·3	0·95	7·3
13	1·40	24·2	0·95	7·3	0·92	6·3
14	1·32	20·8	0·95	7·3	0·91	6·0
15	1·30	20·0	0·95	7·3	0·90	5·7
16	1·30	20·0	0·92	6·3	0·88	5·1
17	1·25	18·0	0·91	6·0	0·86	4·5
18	1·25	18·0	0·89	5·4	0·85	4·2
19	1·19	15·6	0·85	4·2	0·80	2·6
20	1·12	13·0	0·88	5·1	0·80	2·6
21	1·10	12·3	0·90	5·7	0·80	2·6
22	1·08	11·6	0·84	3·8	0·82	3·2
23	0·98	8·3	0·82	3·2	0·80	2·6
24	1·02	9·2	0·82	3·2	0·80	2·6
25	1·05	10·6	0·82	3·2	0·80	2·6
26	1·00	8·9	0·82	3·2	0·80	2·6
27	0·96	7·6	0·80	2·6	0·86	4·5
28	0·94	7·0	0·80	2·6	0·82	3·2
29	0·96	7·6	0·78	2·1	0·76	1·5
30	0·94	7·0	0·79	2·4	0·82	3·2
31			0·78	2·1	0·80	2·6

Guichon Creek, above Mamit Lake, for 1911.

September.		October.		November.		December.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
0·80	2·6	0·80	2·6	0·80	2·6	0·8	3·2	1
0·82	3·2	0·80	2·6	0·80	2·6	0·8	3·2	2
0·80	2·6	0·80	2·6	0·80	2·6	0·8	3·2	3
0·82	3·2	0·82	3·2	0·80	2·6	0·8	3·2	4
0·90	5·7	0·82	3·2	0·82	3·2	0·86	4·5	5
0·85	4·2	0·82	3·2	0·88	5·1	0·85	4·2	6
0·85	4·2	0·81	2·9	0·88	5·1	0·87	5·0	7
0·85	4·2	0·80	2·6	0·88	5·1	0·87	5·0	8
0·82	3·2	0·80	2·6	0·88	5·1	0·87	5·0	9
0·82	3·2	0·80	2·6	0·88	5·1	0·87	5·0	10
0·79	2·4	0·80	2·6	0·88	5·1	0·87	5·0	11
0·78	2·1	0·80	2·6	0·84	3·8	0·87	5·0	12
0·85	4·2	0·80	2·6	0·82	3·2	0·87	5·0	13
0·86	4·5	0·80	2·6	0·80	2·6	0·87	5·0	14
0·85	4·2	0·80	2·6	0·80	2·6	0·87	5·0	15
0·80	2·6	0·80	2·6	0·80	2·6	0·87	5·0	16
0·85	4·2	0·80	2·6	0·80	2·6	0·90	5·7	17
0·84	3·8	0·80	2·6	0·80	2·6	0·90	5·7	18
0·84	3·8	0·80	2·6	0·80	2·6	0·90	5·7	19
0·81	2·9	0·82	3·2	0·80	2·6	0·90	5·7	20
0·81	2·9	0·82	3·2	0·90	5·7	0·90	5·7	21
0·82	3·2	0·80	2·6	0·90	5·7	0·90	5·7	22
0·82	3·2	0·80	2·6	0·89	5·4	0·90	5·7	23
0·84	3·8	0·80	2·6	0·88	5·1	0·90	5·7	24
0·82	3·2	0·80	2·6	0·82	3·2	0·90	5·7	25
0·82	3·2	0·80	2·6	0·85	4·2	0·90	5·7	26
0·85	4·2	0·80	2·6	0·85	4·2	0·90	5·7	27
0·82	3·2	0·80	2·6	0·85	4·2	0·87	5·0	28
0·82	3·2	0·80	2·6	0·82	3·2	0·87	5·0	29
0·82	3·2	0·80	2·6	0·82	3·2	0·90	5·7	30
		0·80	2·6			0·90	5·7	31

Monthly Discharge of Guichon Creek, above Mamit Lake, for 1911.
(Drainage area, 315 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	61·4	7·0	26·2	0·08	0·09	1,559	
July	8·9	2·1	5·5	0·01	0·01	338	
August	9·2	1·5	4·5	0·01	0·01	277	
September	5·7	2·1	3·4	0·01	0·01	202	
October	3·2	2·6	2·7	0·01	0·01	166	
November	5·7	2·6	3·7	0·01	0·01	220	
December	5·7	3·2	5·0	0·01	0·01	307	
The period							11

Note.—Station was established June 3, 1911, after the freshet was past. Partial winter conditions existed from the middle of November to the end of the year. Gauge readings were taken, and the discharge estimated, allowing for the winter conditions.

Accuracy, "A" up to November 15. Accuracy "B" from November 15 to December 31.

DAILY GAUGE HEIGHT AND DISCHARGE of

Day.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.	
	Gauge height.	Discharge.	Guage height.	Discharge.	Gauge height.	Discharge.	Guage height.	Discharge.	Guage height.	Discharge.	Guage height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	5·0	.....	4·0	.....	6·0	1·33	19·8	2·77	98	3·00	115
2	.....	5·0	.....	4·0	.....	6·0	1·35	20·7	2·91	108	2·83	102
3	.....	5·0	.....	4·0	.....	6·0	1·65	34·5	3·16	125	2·70	94
4	.....	5·0	.....	5·0	.....	6·0	1·61	32·5	3·35	135	2·53	84
5	.....	5·0	.....	5·0	.....	6·0	1·50	27·0	4·00	180	2·40	76
6	.....	4·0	.....	5·0	.....	6·0	1·57	30·5	4·48	215	2·38	75
7	.....	4·0	.....	5·0	.....	6·0	1·65	34·5	4·98	260	2·18	63
8	.....	4·0	.....	5·0	.....	6·0	1·60	32·0	5·18	285	2·13	60
9	.....	4·0	.....	5·0	.....	6·0	1·62	33·0	5·38	305	1·99	52
10	.....	4·0	.....	5·0	.....	7·0	1·75	39·5	5·58	330	1·87	45
11	.....	4·0	.....	5·0	.....	7·0	1·68	36·0	5·78	360	1·78	41
12	.....	3·0	.....	5·0	.....	7·0	1·55	29·5	6·02	410	1·70	37
13	.....	3·0	.....	5·0	.....	7·0	1·57	30·5	6·05	420	1·68	36
14	.....	3·0	.....	5·0	.....	7·0	1·68	36·0	6·05	420	1·67	35·5
15	.....	3·0	.....	5·0	.....	7·0	1·67	35·5	6·10	430	1·71	37·5
16	.....	3·0	.....	5·0	.....	7·0	1·65	34·5	6·12	435	1·80	42·0
17	.....	3·0	.....	5·0	.....	7·0	1·58	31·0	6·10	430	1·81	42·5
18	.....	2·0	.....	5·0	.....	7·0	1·57	30·5	6·00	410	1·75	39·5
19	.....	2·0	.....	5·0	.....	7·0	1·45	25·0	5·89	380	1·62	33
20	.....	2·0	.....	5·0	.....	7·0	1·40	23·0	5·65	340	1·64	34
21	.....	2·0	.....	5·0	.....	7·0	1·53	28·5	5·39	310	1·59	31·5
22	.....	2·0	.....	5·0	.....	7·0	1·50	27·0	5·26	290	1·53	28·5
23	.....	2·0	.....	5·0	.....	7·0	1·56	30·0	5·10	275	1·48	26·2
24	.....	2·0	.....	5·0	.....	7·0	1·55	29·5	5·05	270	1·40	23·0
25	.....	2·0	.....	5·0	.....	10·0	1·55	29·5	4·55	220	1·35	20·7
26	.....	2·0	.....	5·0	.....	11·0	1·55	29·5	4·47	215	1·30	18·5
27	.....	3·0	.....	5·0	.....	10·0	1·85	44·5	4·15	190	1·25	16·8
28	.....	4·0	.....	5·0	.....	8·0	1·92	48·1	3·78	165	1·21	15·3
29	.....	4·0	.....	5·0	.....	9·0	2·18	62·8	3·50	145	1·26	17·1
30	.....	4·0	.....	.....	.....	10·0	2·45	79·0	3·27	130	1·28	17·8
31	.....	4·0	.....	.....	.....	15·0	.....	.....	3·15	125	.....	.....

SESSIONAL PAPER No. 25f

Guichon Creek, above Mamit Lake, for 1912.

July.		August.		September.		October.		November.		Day.
Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
1·30	18·5	1·3	18·5	1·3	18·5	1·20	15·0	1·20	15·0	1
1·46	25·4	1·3	18·5	1·3	18·5	1·20	15·5	1·17	12·8	2
1·67	35·5	1·3	18·5	1·42	23·8	1·20	15·0	1·20	15·0	3
1·62	33	1·3	18·5	1·45	25·0	1·20	15·0	1·20	15·0	4
1·58	31	1·3	18·5	1·6	32·0	1·20	15·0	1·20	15·0	5
1·77	40·5	1·28	17·8	1·47	25·8	1·20	15·0	1·20	15·0	6
1·75	39·5	1·21	15·3	1·62	33·0	1·20	15·0	1·15	13·0	7
.....	37·5	1·20	15·0	1·55	29·5	1·20	15·0	1·15	13·0	8
1·67	35·5	1·20	15·0	1·47	25·8	1·20	15·0	1·20	15·0	9
1·6	32·0	1·20	15·0	1·4	23·0	1·20	15·0	1·20	15·0	10
1·61	32·5	1·51	27·5	1·4	23·0	1·20	15·0	1·20	15·0	11
1·75	39·5	1·63	33·5	1·36	21·2	1·25	17·0	1·22	15·7	12
1·72	38·0	1·38	22·1	1·31	19·0	1·25	17·0	1·27	17·4	13
1·63	33·5	1·41	23·4	1·26	17·1	1·22	15·7	1·20	15·0	14
1·56	30	1·57	30·5	1·20	15·0	1·20	15·0	...	...	15
1·47	25·8	1·47	25·8	1·20	15·0	1·20	15·0	...	...	16
1·41	23·4	1·54	29·0	1·20	15·0	1·40	23·0	...	...	17
1·33	19·8	1·58	31·0	1·20	15·0	1·60	32·0	...	...	18
1·3	18·5	1·62	33·0	1·16	13·4	1·20	15·0	...	...	19
1·41	23·4	1·84	44·0	1·15	13·0	1·20	15·0	...	...	20
1·45	25·0	1·65	34·5	1·13	12·2	1·21	15·3	...	...	21
.....	26·0	1·58	31·0	1·14	12·6	1·20	15·0	...	...	22
.....	27·0	1·60	32·0	1·15	13·0	1·22	15·7	...	...	23
1·52	28·0	1·61	32·5	.....	12·3	1·20	15·0	...	...	24
1·60	32·0	1·44	24·6	.....	11·6	1·20	15·0	...	...	25
1·8	42·0	1·36	21·2	1·10	11·0	1·20	15·0	...	...	26
1·65	34·5	1·3	18·6	1·12	11·8	1·20	15·0	...	...	27
1·53	28·5	1·3	18·5	1·15	13·0	1·20	15·0	...	...	28
1·46	25·4	1·26	17·1	1·15	13·0	1·20	15·0	...	...	29
1·42	23·8	1·25	16·8	1·15	13·0	1·20	15·0	...		30
1·36	21·2	1·3	18·5	.....	.....	1·20	15·0	...		31

MONTHLY DISCHARGE of Guichon Creek, above Mamit Lake, for 1912.

(Drainage area, 315 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
January	5·0	2·0	3·3	0·01	0·01	203	
February	5·0	4·0	5·0	0·01	0·01	288	
March	15·0	6·0	7·5	0·02	0·02	461	
April	79	19·8	34·1	0·11	0·1	2,030	
May	435	9·8	271	0·86	1·0	16,660	
June	115	17·1	45·3	0·14	0·2	2,700	
July	40·5	18·5	29·9	0·09	0·1	1,840	
August	44	15	23·7	0·07	0·1	1,460	
September	33	11	18·2	0·06	0·06	1,080	
October	32	15	16	0·05	0·06	984	
The period							12

NOTE.—During January, February and March, winter conditions existed. Gauge readings were taken, and discharges were estimated allowing for ice conditions.

Accuracy "B" during January, February and March. Accuracy "A" during the open season.

HAT CREEK (216-218.)

Hat creek is an important and contentious irrigation stream, in the Dry Belt of British Columbia. It rises in the hills about 15 miles west of Ashcroft, in the Hat Creek Forest Reserve, at an elevation of about 4,300 feet; and, after flowing northerly for nearly 40 miles, discharges into Bonaparte river from the west, about 14 miles from Ashcroft, at an elevation of about 2,000 feet.

It is part of the Bonaparte-Thompson drainage. The drainage area of Hat creek above the mouth is about 240 square miles, and above the Hammond diversion is about 47 square miles.

The creek varies in width from 15 to 20 feet, and is from 1 to 3 feet deep.

The precipitation at the mouth is only about from 9 inches to 10 inches, while at Upper Hat creek it probably is from 10 inches to 12 inches.

The summers are quite hot and generally dry, the evenings being cool. The winters are long and severe. The snowfall in Upper Hat creek is about 4 feet, but is less near the mouth.

Hat Creek valley is mostly timbered with bull pine, poplar and some willow, with a few open patches of land.

The hills are mostly open range lands, or timbered with bull pine, jack pine, spruce and fir.

The valley varies in width from one mile to several hundred yards. The hills in the upper part of the watershed rise to a height of 5,000 feet above the sea.

The upper bench lands, owing to their elevation above Hat creek, cannot be irrigated from the main stream, and several of the small tributaries are used, but the supply of water is not sufficient to give promise of much future development.

In the valley there are a number of good farms and ranches, all requiring irrigation. The soil is mostly a sandy loam, with sandy and gravelly subsoil. Near the lower part of the valley, fruit is successfully grown, but in the upper valley of Hat creek ranching and mixed farming must be resorted to.

Hat Creek ranch at the mouth of Hat creek uses water for irrigation. Water is also used by Robertson, Duck (Chinaman) Parke, Darragh, Smith, Pocock, King, and Colley, while the Indians in the lower valley use a little. In Upper Hat creek the growing season is short, and not as much water is necessary as near the mouth.

Exclusive of several water records on small tributaries there is a total of 8,450 miner's inches (237 c.f.s.) recorded on Hat creek. Many of these records, appurtenant to land in Bonaparte valley, have never been used nor probably will be, owing to impracticability and the heavy expense involved in the construction of the necessary irrigation works. It is probable that many of these old records will be cancelled by the British Columbia Board of Investigation.

There are also several water records allowing the diversion of water from Upper Hat creek into the Oregon Jack creek divide, for use on lands near Ashcroft.

Mr. W. H. Hammond, who owns the Basque ranch, holds the Minnaberriet and Langley records for about 600 miner's inches dated 1871 and 1883; and diverts water from Upper Hat creek at Colley's homestead. His canal is about 2 miles long, and delivers the water into the Oregon Jack Creek Divide reservoir site, whence it gradually seeps into Oregon Jack creek, and down that stream to Hammond's ditch to Basque ranch. A considerable amount of this water is lost through seepage, percolation and evaporation in the swampy reservoir.

From June 17 to September 26, 1911, the Hammond diversion was opened, and about 1,400 acre-feet were diverted. The maximum quantity at any time was 14 c.f.s.

In 1912 the diversion was open from May 9 to August 26, during which time about 1,800 acre-feet were taken from the stream.

See discharge of Hammond's ditch for 1912, hereinafter.

The Ashcroft Water, Electric and Improvement Company also holds a record from Upper Hat creek for 1,000 miner's inches, dated 1906, allowing the diversion of the surplus waters of Hat creek, said waters to be stored in the same Oregon Jack Creek Divide reservoir, then taken down Oregon Jack creek, to be used on certain lands west and north of Ashcroft.

This record has never been operated, and there is a dispute between this company and the owner of the Basque ranch regarding the rights to use the Oregon Jack Creek Divide reservoir.

The company proposes to construct large storage works, dams, etc., sufficient to store from 8,000 to 10,000 acre-feet. This would be a very expensive undertaking, and it is doubtful if sufficient water could be obtained from Upper Hat creek to justify the expense. In 1911, the total run-off of Upper Hat creek at Hammond's diversion was slightly less than 5,000 acre-feet. In 1912 it was 5,600 acre-feet. These are only average years, but it is doubtful if the total yearly flow ever exceeds 7,000 or 8,000 acre-feet.

The dispute between the two rival record holders will have to be settled by the British Columbia Board of Investigation. In the meantime the reservoir, which is Dominion land, has not been granted to either applicant.

Hat creek has many small tributaries, viz.: (from the left going upstream), Boundary, Parks, Cattle, Medicine, and Blue-earth creeks; (from the right going upstream) Graves, Anderson, Pocock, King, and Colley creeks. Miscellaneous measurements of discharge have been taken on several of these tributaries.

At the head of Blue-earth creek, which enters above Hammond's diversion, is a small storage lake, Blue-earth lake. For details of Blue-earth reservoir, *see* 'Blue-earth Creek.'

There have been several hydrographic stations established on Hat creek, viz.: Hat creek (at Colley's ranch), Hammond's ditch, and Hat creek (at Hat Creek ranch, near mouth). These are all discussed separately hereinafter.

Numerous miscellaneous measurements have been taken for special investigations. At Pocock's ranch, about a mile or so below Hammond's diversion, measurements were made to ascertain the amount of water that sinks between these two points.

Measurements were also made at Hat Creek ranch showing the quantity of water used there for irrigation.

Measurements were taken to find the loss in the Hammond ditch between the intake and the reservoir in Oregon Jack divide.

Hat Creek, at Colley's Ranch (216).

This station was established on April 22, 1911, by E. M. Dann. There are two gauges. One is several hundred yards below Hammond's intake, and just above Colley creek. It is a standard vertical staff gauge, 8 feet long, nailed to an alder tree on the left bank of Hat creek. It is referred to three bench-marks.

The second gauge is about 100 yards above Hammond's intake. It is a standard vertical staff gauge near the right bank. It is referred to three bench-marks.

The lower gauge only is read when Hammond's diversion is not in use, and the whole flow of upper Hat creek is recorded. When the Hammond headgate is open, the lower gauge registers the amount of water not diverted.

The upper gauge is read only when the Hammond headgate is open, and registers the whole discharge of Upper Hat creek.

When Hammond's headgate is closed, all measurements are made in the box flume of the intake, which is a timber flume 14 feet wide with level plank bottom and vertical sides. Measurements are made with small electric current meter with wading rods.

When the headgate is open, measurements are made by the wading method, just above and below the intake.

Hat Creek, in Hammond's Ditch (217).

Hammond's ditch diverts water from Upper Hat creek at Colley's ranch, about 22 miles from the mouth of the stream. It discharges the water into a large swampy reservoir in the divide between Hat creek and Oregon Jack creek, whence the water runs into Oregon Jack creek, and is used for irrigation on the Basque ranch, southwest of Ashcroft, in the Thompson drainage area. A large quantity of the water diverted by Hammond's ditch is lost by seepage and evaporation in the so-called reservoir before it reaches Oregon Jack creek.

The ditch is nearly two miles long. It is mostly side-hill ditch, with several lengths of timber fluming. It runs along the lower contour of the hills to the south of the divide. The ditch is about 6 feet wide and 2 feet deep. It has a maximum capacity of about 20 c.f.s. The greatest quantity that has yet been diverted at any time is 14 c.f.s., the mean velocity being only 1·5 feet per second.

A regular gauging station was established in Hammond's ditch on May 9, 1912, and the readings were taken until after the headgate was closed on August 26.

The gauge is a vertical staff fastened to the side of the overflow spillway, about 10 feet below the overflow sluiceway, and 100 yards below the intake. The zero of the gauge is referred to one bench-mark.

The meter measurements were made in the spillway box, by means of a current meter attached to a wading rod.

The results of this station show that between May 9, and August 26, 1912, some 1,775 acre-feet were diverted through Hammond's ditch.

In 1911, the amount of water diverted was computed from the difference between the daily discharges recorded by the upper and lower gauges at the gauging station at Colley's ranch. Between June 16 and September 26 about 1,400 acre-feet were diverted.

DISCHARGE MEASUREMENTS of Hat Creek, at Colley's Ranch, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
May 7	E. M. Dann	268	14	15·3	0·76	1·50[1]	11·7
May 15	"	268	14	15·2	1·2	1·61[1]	18·2
May 17	"	268	14	19·1	1·5	1·78[1]	28·7
May 29	"	268	14	21	2·1	1·98[2]	43·5
May 30	"	268	14	24·7	2·6	2·25[3]	75·1
May 31	"	268	14	28·5	3·3	2·31[4]	92·6
July 18	C. G. Cline	1046	8	2·2	0·3	1·07[1]	0·6
Sept. 29	"	1046	16	5·9	0·86	1·31[1]	5·1
April 22	E. M. Dann	268				[6]	4·4
April 28	"	268	10	5·2	0·9	0·16[5]	4·7
May 2	"	268	11	8·3	1·55	0·39[5]	13·0
July 18	C. G. Cline	1046	11	5	0·97	0·16[5]	4·8
Sept. 30	"	1046	13	4·8	0·75	0·15[5]	3·6
1912.							
May 14	C. G. Cline	1046	11	19·8	3·1	2·15[1]	62·0
June 17	B. Corbould	1046	15	5·85	0·8	1·31[1]	4·7
July 11	"	1044	6	3·2	0·6	1·21[1]	1·9
July 31	"	1044	6	3·2	0·5	1·2[1]	1·6
Aug. 19	"	1044	6	2·7	0·4	1·19[1]	1·2
May 14	C. G. Cline	1046	17	21·7	4·0	1·40[5]	87·0
June 17	B. Corbould	1046	12·5	7·5	1·59	0·38[5]	12·0
July 11	"	1044	12·5	8·4	1·9	0·42[5]	15·9
July 31	"	1044	12	5·4	0·98	0·23[5]	5·3
Aug. 19	"	1044	12	6·36	1·4	0·30[5]	9·4

[1]Lower gauge.
[2]Lower gauge, upper gauge, 0.97.
[3]Lower gauge, upper gauge, 1·57.
[4]Lower gauge, upper gauge, 1·41.
[5]Upper gauge.
[6]No gauge height.

Daily Discharge of Hat Creek, at Colley's Ranch, for 1911.

Day.	April.	May.	June.	July.	August.	September.	October.	November.	December.
	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.
	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.
1	.....	11·0	59·8	12·0	1·0	2·0	5·0	3·9	2·2
2	.....	13·0	46·9	12·0	1·0	2·0	4·0	3·9	2·4
3	.....	13·0	36·0	12·0	1·0	4·0	4·5	3·9	2·4
4	.....	12·5	26·5	12·0	1·0	7·5	4·0	4·6	2·4
5	.....	12·5	24·5	12·0	1·0	9·5	4·5	5·1	2·5
6	.....	12·0	23·0	12·0	1·5	9·5	4·0	4·8	2·5
7	.....	12·0	10·5	12·0	7·5	7·5	4·5	4·6	2·4
8	.....	11·2	23·0	12·0	14·0	5·5	4·0	4·1	2·4
9	.....	10·0	21·0	12·0	9·5	5·5	4·0	3·9	2·2
10	.....	10·8	22·0	12·0	7·5	5·5	4·0	3·4	2·2
11	.....	12·5	24·5	12·0	5·5	4·0	4·0	2·5	2·2
12	.....	12·0	26·5	14·0	5·5	5·5	4·0	2·2	2·4
13	.....	16·0	23·0	12·0	5·5	9·5	4·5	1·9	2·4
14	.....	15·0	19·5	12·0	5·5	7·5	4·0	2·2	2·5
15	.....	28·6	12·0	9·5	5·5	5·5	4·5	2·1	2·7
16	.....	33·0	10·5	9·5	5·5	5·5	4·5	2·2	3·2
17	.....	28·6	11·0	5·5	4·0	7·5	4·0	2·4	3·4
18	.....	25·1	12·0	5·5	4·0	5·5	4·0	2·5	3·6
19	.....	27·2	14·0	4·0	4·0	5·5	4·5	2·2	3·4
20	.....	25·8	14·0	4·0	4·0	5·5	4·3	1·9	3·4
21	.....	30·8	14·0	4·0	4·0	5·5	4·3	1·7	3·2
22	4·4	25·1	14·0	5·5	4·0	5·5	3·9	1·9	3·2
23	4·4	20·0	14·0	4·0	4·0	5·5	4·3	2·2	5·2
24	4·5	18·2	12·0	4·0	4·0	5·5	3·9	2·7	3·4
25	4·5	18·2	12·0	4·0	4·0	5·5	3·6	2·5	3·4
26	4·6	17·0	12·0	4·0	4·0	5·5	4·7	2·4	3·9
27	4·6	18·2	12·0	4·0	4·0	4·0	4·1	2·4	3·9
28	4·7	18·2	12·0	4·0	2·0	4·0	4·4	2·2	4·1
29	6·0	18·2	12·0	5·5	2·0	4·0	4·1	2·2	4·1
30	8·0	55·0	12·0	5·5	2·0	4·0	4·4	2·4	4·3
31	.....	62·2	.....	5·5	2·0	.....	3·9	.....	4·3

Monthly Discharge of Hat Creek, at Colley's Ranch, for 1911.

(Drainage area, 47 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	92·6	10·0	20·7	0·44	0·51	1,275	
June	59·8	10·5	19·5	0·42	0·46	1,162	
July	14·0	4·0	8·3	0·18	0·21	510	
August	14·0	1·0	4·2	0·1	0·11	258	
September	9·5	2·0	5·6	0·12	0·13	333	
October	5·0	3·6	4·2	0·1	0·11	258	
November	5·1	1·7	2·9	0·06	0·07	173	
December	4·3	2·2	3·0	0·06	0·07	184	
The period. Estimated	.....	.....	6·6	0·14	2·0	5,000	10

Note.—The station was established on April 22. The mean discharge for April was less than 4 c.f.s. The discharges between June 17 and September 26 are taken from the curve of the gauge above Hammond's diversion (upper gauge), as during that period the Hammond headgate was open, and water was diverted to Oregon Jack Creek divide. The remaining discharges are taken from the station below Hammond's diversion (lower gauge). Winter conditions existed during the month of December. The maximum recorded stage of 2·31 feet occurred about 5 p.m. on May 31, and was 92·6 c.f.s. The mean for the day, however, was only 62·2 c.f.s.

Accuracy, "A."

Daily Discharge of Hat Creek, at Colley's Ranch, for 1912.

Day.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.
	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.
	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.
1	4·8	2·7	1·7	1·7	9·6	23·0	13·0	8·6	5·4	5·0	4·0
2	4·6	2·7	1·7	1·9	11·6	19·0	26·5	6·6	6·2	5·0	4·0
3	4·3	2·7	1·7	1·9	12·5	18·0	23·5	6·2	7·4	5·4	4·0
4	4·3	2·3	1·9	2·2	11·6	17·5	19·5	6·2	6·6	5·6	4·0
5	4·3	2·3	1·9	2·2	13·5	17·0	18·0	6·2	6·2	6·0	4·0
6	4·3	2·0	1·9	2·2	14·5	15·0	17·0	6·6	6·2	5·5	4·0
7	4·1	2·0	1·9	2·2	33·0	14·0	19·0	6·2	7·0	5·0	4·0
8	4·1	2·0	1·9	2·3	30·0	14·5	16·0	7·4	6·6	5·0	4·0
9	3·9	2·0	2·0	2·2	30·4	13·0	15·0	8·2	5·8	4·5	4·0
10	3·9	2·0	2·0	2·2	29·2	12·2	14·5	7·4	5·0	4·5	4·0
11	3·9	1·9	2·0	2·2	37·5	12·2	13·5	7·4	4·8	4·5	4·0
12	4·1	1·9	2·2	2·5	29·8	11·4	14·5	7·4	4·8	4·5	4·0
13	3·9	1·7	2·2	2·2	32·2	11·0	15·5	6·6	4·5	5·0	4·0
14	3·9	1·7	2·0	2·3	65·0	11·0	13·0	6·6	4·5	4·5	4·5
15	3·6	1·7	2·0	2·2	50·0	10·6	13·0	9·8	4·5	4·5	4·0
16	3·6	1·7	1·9	2·3	40·3	11·4	12·6	8·2	4·5	4·5	4·0
17	3·4	1·7	1·9	2·2	27·0	12·2	12·6	8·2	4·2	5·0	4·0
18	3·4	1·6	1·9	2·5	25·5	12·6	11·8	11·8	3·7	5·0	4·0
19	3·2	1·7	1·6	2·5	27·0	15·0	11·8	9·0	3·7	5·0	
20	3·0	1·7	1·6	2·9	28·6	13·0	11·4	8·2	3·7	5·0	
21	2·7	1·7	1·6	2·7	43·8	13·5	10·6	7·4	3·7	5·0	
22	3·0	1·6	1·9	3·4	44·5	15·5	10·2	7·0	3·7	5·0	
23	3·2	1·7	1·9	3·9	47·3	13·0	10·6	6·2	3·7	4·5	
24	3·2	1·7	1·9	4·8	37·5	12·6	11·8	6·2	4·2	4·5	
25	3·9	1·7	1·7	4·6	36·1	11·8	10·2	5·8	3·7	4·5	
26	3·9	1·9	1·7	6·0	30·4	11·0	9·4	5·8	3·7	4·0	
27	4·1	1·9	1·7	6·7	27·0	11·0	8·2	4·8	3·7	4·0	
28	3·9	1·9	1·7	8·0	26·5	11·4	7·4	6·2	3·7	4·0	
29	3·6	1·9	1·6	8·0	25·5	11·0	7·4	5·0	4·0	4·0	
30	3·6		1·6	8·8	27·5	12·6	6·6	4·8	3·7	4·0	
31	3·2		1·6		22·0		6·2	5·0		4·0	

Monthly Discharge of Hat Creek, at Colley's Ranch, for 1912.
(Drainage area, 47 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
January	4·8	2·7	3·8	0·08	0·09	232	
February	2·7	1·6	1·9	0·04	0·04	111	
March	2·2	1·6	1·8	0·04	0·05	112	
April	8·8	1·7	3·4	0·07	0·08	202	
May	65·0	9·6	29·9	0·6	0·7	1,838	
June	23·0	10·6	13·5	0·3	0·33	803	
July	26·5	6·2	13·1	0·3	0·35	805	
August	11·8	4·8	7·0	0·15	0·2	430	
September	7·4	3·7	4·8	0·1	0·1	286	
October	6·0	4·0	4·7	0·1	0·1	289	
November	4·5	4·0	4·0	0·09	0·1	238	
December (estimated)			4·0	0·09	0·1	246	
The year	96	1·6	7·6	0·16	2·2	5,592	12

Note.—Winter conditions existed during January, February and part of March. The maximum recorded storage of 1·44 (gauge height on upper gauge) took place at 8.15 p.m. on May 14, and was 96 c.f.s. This lasted only for a few hours. The mean for that day was 65 c.f.s. Hammond's headgate was opened on May 9, and closed on August 26. Discharges up to May 8 are taken from lower gauge; after May 8 they are taken from the upper gauge, except during October and November, when they are again read from the lower gauge. See also discharges in Hammond's ditch hereinafter.

Accuracy, "A."

DISCHARGE MEASUREMENTS of Hat Creek, in Hammond's Ditch, for 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
July 18	C. G. Cline	1046	6	3·0	1·5	[1]	4·5
1912.							
June 17	Cline and Corbould	1046	6·5	5·8	1·1	0·85	6·8
July 11	B. Corbould	1046	4·2	4·2	2·7	1·05	11·4
July 11	"	1044	4·7	2·8	2·6	0·8	7·2
July 11	"	1044	2·3	0·5	0·9	0·59	0·5
July 12	"	1044	6·0	4·3	3·0	1·20	12·9
July 12	"	1044	4·2	1·3	1·24	0·49	1·6
July 12	"	1044	6·0	4·0	2·8	0·99	11·1
July 12	"	1044	5·0	2·6	2·0	0·71	5·2
July 12	"	1044	5·8	3·6	2·7	0·92	9·8
July 31	"	1044	4·2	1·6	1·2	0·60	1·8
July 31	"	1044	5·2	2·7	2·3	0·78	6·3
Aug. 19	"	1044	4·1	3·0	2·4	0·89	7·2
Aug. 19	"	1044	4·0	3·1	1·8	[2]	5·9

[1] No gauge height.
[2] Measured at outlet into reservoir, showing loss of 1·3 c.f.s. in 2 miles.

SESSIONAL PAPER No. 25f

Daily Discharge of Hat Creek, in Hammond's Ditch, for 1912.

Day.	May.	June.	July.	August.
	Discharge.	Discharge.	Discharge.	Discharge.
	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.
1		10·5	11·2	5·8
2		10·2	11·2	5·4
3		10·2	12·3	5·2
4		10·2	12·3	5·2
5		9·8	13·2	5·2
6		9·5	13·0	5·0
7		9·5	14·0	4·8
8		9·5	13·0	5·2
9	5·3	9·8	12·0	5·8
10	5·5	9·8	11·3	5·4
11	4·5	9·8	11·3	5·4
12	4·0	9·5	11·2	5·4
13	4·0	7·6	11·2	4·9
14	8·6	7·6	11·0	4·9
15	6·0	7·4	11·0	5·6
16	6·0	7·4	10·8	5·2
17	5·0	6·4	10·5	5·2
18	5·0	6·4	10·2	9·5
19	5·5	9·0	10·2	7·4
20	5·6	9·5	9·5	7·0
21	10·0	10·2	9·0	6·4
22	10·8	10·2	8·6	·0
23	10·5	9·5	8·3	·0
24	10·8	9·8	8·3	5·0
25	10·5	9·8	7·6	4·8
26	10·2	9·5	7·2	·0
27	10·8	10·0	6·4	·0
28	11·0	9·8	6·0	·0
29	10·8	10·5	5·6	·0
30	9·8	11·2	5·6	·0
31	10·8		5·3	·0

Monthly Discharge of Hat Creek, in Hammond's Ditch, for 1912.

Month.	Discharge in Second-Feet.			Run-Off.
	Maximum	Minimum	Mean.	Total in acre-feet.
May	11·0	4·0	5·8	356
June	11·2	6·4	9·3	553
July	14·0	5·3	9·9	608
August	9·5	·0	4·2	258

Total quantity of water diverted = 1,775.

Note.—Accuracy "B."

HAT CREEK AT HAT CREEK RANCH, UPPER STATION (218).

A station was established on Hat creek at Hat Creek ranch near the mouth of the creek, on May 9, 1911, by E. M. Dann. The station was located just above the irrigation intake of Hat Creek ranch. Gauge No. 2 was drowned out by the construction of a temporary diverting dam just below the gauge, on June 18, 1912, and gauge No. 3 was set in place thereof. Gauge No. 3 is a vertical staff, 4 feet long, and it is fastened to a small tree, on the left bank, near the wagon road leading from the Cariboo road to Lillooet. It is about one-quarter mile from the Cariboo road, and the same distance from Hat Creek ranch house. The gauge is referred to three bench-marks. Measurements are made with a current meter, by wading. The channel at the station is straight, with good control below the station. The bed of the stream is gravel, with some mud. The banks are from 3 to 4 feet high. The right bank is covered with thick brush, and the left bank is open. There is but one channel at all stages, and it is not inclined to overflow.

All discharges up to June 18, 1912, are taken from a rating curve of the old gauge No. 2. From that date they are taken from gauge No. 3.

The gauge readings are made daily by the Hat Creek Ranch foreman. The station was maintained during the irrigation season only.

DISCHARGE MEASUREMENTS of Hat Creek, at Hat Creek Ranch (Upper Station,) 1911-12

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
June 11	E. M. Dann	268	33·5	46·5	3·4	2·05[1]	159·
May 14	"	268				1·05[1]	28·3
July 21	C. G. Cline	1046	12	4·2	1·4	0·42[1]	5·8
Sept. 28	"	1046	26	17·1	0·9	0·89[1]	16·1
1912.							
April 25	"	1046	24	18·4	1·0	0·92[1]	19·0
May 9	"	1046	28	44·4	2·4	1·83[1]	105·
May 15	"	1046	30	60·9	3·6	2·35[1]	222·
June 16	"	1046	26	31·1	1·3	1·38[1]	39·6
July 12	B. Corbould	1044	27	24·6	2·4	7·38[2]	58·7
July 30	"	1044	27	22·2	1·5	7·10[2]	33·1
August 27	"	1044	26	20·7	1·4	7·05[2]	28·0

[1]Gauge No. 2.
[2]Gauge No. 3.

DAILY GAUGE HEIGHT AND DISCHARGE of Hat Creek, at Hat Creek Ranch (Upper Station), for 1911.

Day.	May.		June.		July.		August.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			2·0	141	1·0	22	0·35	5
2			2·1	163	0·9	18	0·4	6
3			1·9	120	0·9	18	0·4	6
4			1·7	83	0·8	15	0·4	6
5			1·6	68	0·8	15	0·4	6
6			1·5	55	0·8	15	0·6	10
7			1·5	55	0·7	12	1·05	24
8			1·5	55	0·7	12	1·25	34
9	1·15	28	1·5	55	0·7	12	1·25	34
10	1·1	26	1·5	55	0·8	15	1·2	31
11	1·1	26	1·5	55	0·8	15	1·1	26
12	1·15	28	1·8	100	0·75	14	1·0	22
13	1·15	28	1·8	100	0·7	12	0·9	18
14	1·2	31	1·7	83	0·65	11	0·8	15
15	1·2	31	1·6	68	0·75	14	0·8	15
16	1·3	55	1·5	55	0·65	11	0·85	16
17	1·5	55	1·4	45	0·65	11	0·8	15
18	1·5	55	1·3	38	0·6	10		
19	1·5	55	1·2	31	0·6	10		
20	1·5	55	1·2	31	0·6	10		
21	1·6	68	1·2	31	0·5	8		
22	1·55	62	1·1	26	0·55	9		
23	1·4	45	1·1	26	0·5	8		
24	1·35	42	1·05	24	0·5	8		
25	1·3	38	1·0	22	0·5	8		
26	1·3	38	1·0	22	0·45	7		
27	1·3	38	0·9	18	0·4	6		
28	1·3	38	0·9	18	0·4	6		
29	1·35	42	0·9	18	0·4	6		
30	1·6	68	1·0	22	0·35	5		
31	1·9	120			0·35	5		

MONTHLY DISCHARGE of Hat Creek, at Hat Creek Ranch (Upper Station), for 1911. (Drainage area, 240 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	120	26	46·6	0·19	0·22	2,865	
June	163	18	56·1	0·23	0·26	3,338	
July	22	5	11·2	0·05	0·06	688	
The period							10

NOTE.—For 1911 gauge No. 2 was used. See note on 1912 sheet for gauge No. 3. Owing to the diversion of water in Hammond's ditch near the headwaters of Hat creek, this station does not give the total run-off of the stream.

Accuracy "A."

DAILY DISCHARGE of Hat Creek, at Hat Ranch (Upper Station), for 1912.

DAY.	APRIL.	MAY.	JUNE.	JULY.	AUGUST.
	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.
	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.
1		22	83	48	35
2		26	83	50	36
3		26	68	54	.....
4		26	55	61	.....
5		22	55	71	.....
6		31	45	78	.....
7		55	38	90	.....
8		68	38	86	.....
9		83	38	72	.....
10		83	31	58	.....
11		141	31	49	.....
12		187	31	56	.....
13		120	51	52	.....
14		163	40	52	.....
15		187	40	39	.....
16		187	40	39	.....
17		212	40	38	.....
18		163	40	35	.....
19		141	39	36	.....
20		141	39	38	.....
21		187	39	40	.....
22		200	39	43	.....
23		212	39	37	.....
24		212	39	39	.....
25	18	187	41	40	.....
26	18	163	41	49	.....
27	18	163	42	47	.....
28	18	141	43	39	.....
29	22	120	44	32	.....
30	22	110	44	32	.....
31		100	.....	32	.....

MONTHLY DISCHARGE of Hat Creek, at Hat Creek Ranch (Upper Station), for 1912.
(Drainage area, 240 square miles.)

MONTH.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	212	22	125·1	0·52	0·60	7,686	
June	83	31	43·9	0·18	0·20	2,582	
July	90	32	46·2	0·19	0·22	2,841	
The period							10

NOTE.—Measurements up to June 18, 1912, were made at gauge No. 2. At that date it was found that a temporary diverting dam had been thrown across the stream below the gauge, and it was affecting the height of the water at the gauge. So gauge No. 3 was established higher up the creek, and No. 2 was abandoned. Owing to the diversion of water in Hammond's ditch near the headwaters of Hat creek, this station does not give the total run-off of the stream.

Accuracy "A."

Hat Creek, at Hat Creek Ranch, Lower Station (269).

A station was established on Hat creek at Hat Creek ranch near the mouth of the creek, below all diversions, on May 9, 1911, by E. M. Dann. The object of the station was to determine how much water of Hat creek was unused during the irrigation season, on account of the contention on this over-recorded stream. The station also gives the quantity of water used by Hat Creek ranch, by subtracting the discharges from the upper station (No. 218).

The gauge (No. 1) was placed at the lower side of the bridge on the Cariboo road, on the right bank. The datum of the gauge was referred to three bench-marks. The measurements were made by a current meter, by wading at a section just above the bridge.

This station was maintained during the irrigation season of 1911, and then abandoned.

For the discharge measurements made at this station see the list of miscellaneous measurements of discharge.

Daily Gauge Height and Discharge of Hat Creek, at Hat Creek Ranch (Lower Station), for 1911.

Day.	May.		June.		July.		August.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			2·00	116·5	1·10	23·5	0·55	0·9
2			2·10	129·5	1·00	17·0	0·55	0·9
3			2·00	116·5	1·00	17·0	0·50	0·5
4			1·60	68·5	0·90	12·0	0·50	0·5
5			1·45	53·9	0·90	12·0	0·50	0·5
6			1·40	48·0	0·90	12·0	0·70	4·5
7			1·40	48·0	0·80	8·0	1·00	17·0
8			1·40	48·0	0·80	8·0	1·20	30·5
9	0·95	14·5	1·40	48·0	0·80	8·0	1·20	30·5
10	0·90	12·0	1·40	48·0	0·90	12·0	1·15	27·0
11	0·95	14·5	1·60	68·5	0·90	12·0	1·10	23·5
12	1·00	17·0	2·00	116·5	0·85	10·0	1·05	20·0
13	1·00	17·0	2·00	116·5	0·80	8·0	1·00	17·0
14	1·05	20·0	1·80	92·0	0·75	6·0	0·90	12·0
15	1·10	23·5	1·80	92·0	0·70	4·5	0·85	10·0
16	1·50	58·0	1·70	80·0	0·60	1·4	0·90	12·0
17	1·55	63·5	1·50	58·0	0·55	0·9	0·90	12·0
18	1·50	58·0	1·40	48·0	0·50	0·5		
19	1·45	53·0	1·30	39·0	0·40	0		
20	1·50	58·0	1·25	35·0	0·40	0		
21	1·60	68·5	1·25	35·0	0·40	0		
22	1·55	63·0	1·20	30·5	0·55	0·9		
23	1·40	48·0	1·15	27·0	0·55	0·9		
24	1·35	43·5	1·10	23·5	0·55	0·9		
25	1·30	39·0	1·10	23·5	0·55	0·9		
26	1·30	39·0	1·10	23·5	0·60	1·4		
27	1·30	39·0	1·00	17·0	0·60	1·4		
28	1·30	39·0	1·00	17·0	0·55	0·9		
29	1·30	39·0	1·00	17·0	0·55	0·9		
30	1·60	68·5	1·10	23·5	0·60	1·4		
31	1·90	104·			0·60	1·4		

MONTHLY DISCHARGE of Hat Creek, at Hat Creek Ranch (Lower Station), for 1911.

Month.	DISCHARGE IN SECOND-FEET.			RUN-OFF.
	Maximum.	Minimum.	Mean.	Total in acre-feet.
May	104	12	43·4	2,662
June	129	17	56·9	3,385
July	23	0	5·9	363

NOTE.—This station is below all diversions, and shows the amount of water in Hat Creek that was unused.

Accuracy, "B."

HEFFERLY CREEK (236, 237, 238 and 239.)

Hefferly creek (sometimes called Heffly creek) has its source in Hefferly lake, near the divide into Louis creek, at an elevation of 3,100 feet, and flowing westerly empties into North Thompson river, near Hefferly Creek post office, about 14 miles from Kamloops), at an elevation of 1,150 feet. The stream is about 10 miles long, from 15 to 25 feet wide, and from 6 inches to 2 feet deep. Hefferly lake is about 2 miles long and several hundred yards wide, and is used as a storage reservoir for irrigation purposes. The water users have co-operated and constructed a small dam at the outlet of the lake, and the spring freshet is mostly conserved. It is not possible to greatly increase the capacity of the reservoir without damming the easterly end of the lake as well, on account of the low divide into Louis creek.

Hefferly creek, like so many of the streams in the Dry Belt, is vastly over-recorded for irrigation purposes, but by storage and careful use there is enough water for all the lands in the valley and at the mouth. The earliest records are appurtenant to the Austen and Anderson places, near the mouth of the creek, and the waters of the creek are used mostly on these low lands. The Anderson interests have recently been formed into the North Thompson Ranching Company, and it is proposed to construct a high line canal, beginning near the lake, and irrigate several thousand acres of sloping bench lands on the south side of the Hefferly valley. Austen owns a large tract of land at the mouth of the creek, and has purchased some of Anderson's bottom lands. There are several small farms in the valley, but they depend on the water that is not required by Anderson and Austen.

The hills of the Hefferly drainage rise to a height of 4,000 feet, and are fairly well covered with timber, bull pine, jack pine and some fir. The upper slopes are excellent range lands.

The precipitation of Hefferly drainage is probably about 20 inches near the headwaters, which rise near Louis creek and the easterly limit of the Dry Belt. At the mouth of the creek the precipitation is not more than 10 inches per annum, with only a small rainfall during the growing season.

Hefferly Creek, below Hefferly Lake (237, 238 and 239.)

This gauging station is a combination of three stations, viz.: Hefferly creek, upper station (No. 237), Anderson's diversion (No. 238) and Crawshaw's ditch (No. 239). These three stations were established on June 25, 1911, by C. G. Cline, and gauge readings were taken during the irrigation seasons of 1911 and 1912. The object of the three stations was to measure the amount of water used by each ditch, and by combining all three to obtain the total flow of the creek coming from Hefferly lake. Moreover, it was difficult to obtain a gauge reader for a station above the Anderson intake.

A vertical staff gauge was placed at each station, and the datum of each was referred to three bench-marks.

The data of discharge here given were obtained, as has been said, by combining the flow of all three stations. The quantity of water running in the Anderson and Crawshaw ditches is also published.

Hefferly Creek, at Mouth (236).

This station was established on August 19, 1911, by C. G. Cline. It is located above Austen's diversions, near the mouth of the creek, about 100 yards upstream from the Hefferly Creek bridge, and 40 feet from the road. The gauge is a vertical staff, 5 feet long, and is nailed to a fallen fir tree on the left bank of the creek. The datum of the gauge is referred to three bench-marks. The banks are from 3 to 5 feet high and do not overflow at high water. Measurements are made with a current meter by the wading method, at a section about 100 feet below the gauge. This station shows the total flow of Hefferly creek, except that which is used by Anderson and Crawshaw, and includes the flow of Edwards creek. Hefferly creek below the Austen headgates is dry during the irrigation season, as nearly all the water is used.

Discharge Measurements of Hefferly Creek, at mouth, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
Aug. 19	C. G. Cline	1046	6·5	3·0	0·4	0·81	1·3
Sept. 13	"	1046	7·0	3·6	0·5	0·88	1·9
1912.							
April 3	"	1057	6·0	3·6	0·8	1·0	3·0
May 13	E. M. Dann	1044	12·5	16·1	3·5	2·05	54·8
May 14	"	1044	15·5	19·3	3·7	2·2	71·7
May 30	"	1044	9·0	8·2	2·9	1·6	23·3
June 10	"	1044	8·0	3·6	1·0	1·0	3·6
Aug. 19	H. J. Keys	1057	8·5	3·4	1·7	1·06	5·8

DAILY GAUGE HEIGHT AND DISCHARGE of Hefferly Creek, at mouth, for 1911.

Day.	August.		September.		October.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·82	1·4	0·85	1·6
2			0·82	1·4	0·87	1·8
3			0·82	1·4	0·87	1·8
4			0·82	1·4	0·87	1·8
5			0·82	1·4	0·9	2·0
6			0·82	1·4	0·9	2·0
7			0·85	1·6	0·92	2·3
8			0·85	1·6	0·92	2·3
9			0·85	1·6	0·87	1·8
10			0·85	1·6	0·87	1·8
11			0·85	1·6	0·87	1·8
12			0·85	1·6	0·87	1·8
13			0·82	1·4	0·87	1·8
14			0·82	1·4	0·9	2·0
15			0·82	1·4	0·9	2·0
16			0·82	1·4	0·9	2·0
17			0·82	1·4	0·9	2·0
18			0·82	1·4	0·9	2·0
19	0·8	1·3	0·82	1·4	0·9	2·0
20	0·85	1·6	0·8	1·3	0·9	2·0
21	0·85	1·6	0·8	1·3	0·9	2·0
22	0·85	1·6	0·8	1·3	0·9	2·0
23	0·85	1·6	0·8	1·3	0·9	2·0
24	0·82	1·4	0·82	1·4	0·9	2·0
25	0·82	1·4	0·82	1·4	0·95	2·8
26	0·8	1·3	0·82	1·4	0·95	2·8
27	0·8	1·3	0·82	1·4	0·95	2·8
28	0·8	1·3	0·85	1·6	0·95	2·8
29	0·8	1·3	0·85	1·6	1·1	6·3
30	0·82	1·4	0·85	1·6	1·17	8·0
31	0·82	1·4			1·17	8·0

MONTHLY DISCHARGE of Hefferly Creek, at mouth, for 1911.
(Drainage area, 65 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
August	1·6	1·3	1·4	0·02	0·02	86
September	1·6	1·3	1·4	0·02	0·02	83
October	8·0	1·6	2·6	0·04	0·05	160

NOTE.—This station was not established till the latter end of August. It would be impossible to estimate the freshet flow for 1911, but it would be considerably smaller than that of 1912, which was an exceptionally wet year.

Accuracy, "A."

SESSIONAL PAPER No. 25f

DAILY GAUGE HEIGHT AND DISCHARGE of Hefferly Creek, at mouth, for 1912.

Day.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·35	13·5	1·6	23·2	0·95	2·8	1·1	6·3	1·1	6·3
2			1·85	38·1	1·5	19·0	1·0	3·7	1·1	6·3	1·1	6·3
3	1·0	3·7	1·7	28·5	1·4	15·2	1·1	6·3	1·05	5·0	1·15	7·5
4	1·0	3·7	1·65	25·8	1·3	11·8	1·15	7·5	1·05	5·0	1·15	7·5
5	1·0	3·7	1·7	28·5	1·25	10·3	1·4	15·2	1·05	5·0	1·15	7·5
6	1·0	3·7	1·7	28·5	1·2	8·8	1·3	11·8	1·0	3·7	1·1	6·3
7	1·0	3·7	1·85	38·1	1·2	8·8	1·3	11·8	1·0	3·7	1·2	8·8
8	1·0	3·7	2·05	55	1·2	8·8	1·3	11·8	1·0	3·7	1·2	8·8
9	1·0	3·7	2·2	72	1·1	6·3	1·2	8·8	1·0	3·7	1·2	8·8
10	1·05	5·0	2·2	72	1·1	6·3	1·2	8·8	1·0	3·7	1·2	8·8
11	1·07	5·5	2·1	60	0·95	2·8	1·15	7·5	1·0	3·7	1·15	7·5
12	1·3	11·8	2·1	60	1·0	3·7	1·15	7·5	1·0	3·7	1·15	7·5
13	1·15	7·5	2·1	60	1·1	6·3	1·15	7·5	1·0	3·7	1·1	6·3
14	1·15	7·5	2·2	72	1·1	6·3	1·15	7·5	1·0	3·7	1·1	6·3
15	1·1	6·3	2·5	108	1·3	11·8	1·1	6·3	1·0	3·7	1·1	6·3
16	1·1	6·3	2·5	108	1·3	11·8	1·0	3·7	1·0	3·7		
17	1·1	6·3	2·4	96	1·2	8·8	1·0	3·7	1·0	3·7		
18	1·0	3·7	2·3	84	1·0	3·7	1·0	3·7	1·1	6·3		
19	1·0	3·7	2·2	72	0·9	2·0	1·0	3·7	1·1	6·3		
20	1·0	3·7	2·2	72	0·95	2·8	1·0	3·7	1·1	6·3		
21	1·0	3·7	2·0	50	0·95	2·8	1·0	3·7	1·05	5·0		
22	1·0	3·7	1·9	41·7	1·0	3·7	1·0	3·7	1·05	5·0		
23	1·0	3·7	1·9	41·7	1·1	6·3	1·15	7·5	1·05	5·0		
24	1·0	3·7	1·9	41·7	1·1	6·3	1·15	7·5	1·05	5·0		
25	1·05	5·0	1·95	45·9	1·0	3·7	1·3	11·8	1·05	5·0		
26	1·05	5·0	1·95	45·9	1·15	7·5	1·3	11·8	1·0	3·7		
27	1·05	5·0	1·85	38·1	1·35	13·5	1·25	10·3	1·0	3·7		
28	1·1	6·3	1·8	34·5	1·35	13·5	1·2	8·8	1·0	3·7		
29	1·1	6·3	1·7	28·5	1·1	6·3	1·2	8·8	1·05	5·0		
30	1·25	10·3	1·7	28·5	1·0	3·7	1·15	7·5	1·05	5·0		
31			1·6	23·2			1·1	6·3	1·05	5·0		

MONTHLY DISCHARGE of Hefferly Creek, at mouth, for 1912.

(Drainage area, 65 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
April	11·8	3·7	5·2	·08	·09	309
May	108	13·5	5·2	·80	·92	3,200
June	23·2	2·0	8·2	·13	·14	488
July	15·2	2·8	7·5	·12	·14	461
August	6·3	3·7	4·6	·07	·08	282

NOTE.—Accuracy, "A."

DISCHARGE MEASUREMENTS of Hefferly Creek, below Hefferly Lake, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
	In Hefferly Cr. below Anderson and Crawshaw Ditches.						
June 25, 1911	C. G. Cline	1046	5·0	3·6	2·2	1·23	8·0
Aug. 14, 1911	"	1046	3·0	0·6	0·7	0·85	0·4
May 14, 1912	E. M. Dann	1044	11	10·5	2·9	1·68	30·1
May 15, 1912	"	1044	12	18·5	3·7	.....	68·5
May 30, 1912	"	1044	6	4·5	2·8	1·42	12·7
June, 9, 1912	"	1044	4·5	1·5	0·7	1·0	1·1
Aug. 20, 1912	H. J. Keys	1057	2·5	0·7	2·5	0·99	1·8
	In Anderson's Ditch.						
June 26, 1911	C. G. Cline	1046	6·0	4·4	2·2	1·41	9·5
Aug. 14, 1911	"	1046	5·0	1·7	0·65	0·77	1·1
Sept. 18, 1911	"	1046	3·0	1·3	0·73	0·71	1·0
May 14, 1912	E. M. Dann	1044	4·0	3·4	1·8	1·05	6·2
Aug. 20, 1912	H. J. Keys	1057	7·0	3·6	1·4	1·12	5·2
	In Crawshaw's Ditch.						
June 26, 1911	C. G. Cline	.....	2·0	0·5	2·0	0·2	1·0
Aug. 14, 1911	"	.....	2·0	0·3	1·2	0·1	0·4

NOTE.—There are three gauges, one in the creek, and one in each ditch. The combined discharges give the flow of Hefferly creek below Hefferly lake.

MONTHLY DISCHARGE of Hefferly Creek, below Hefferly Lake, for 1911.

(Drainage area, 30 square miles.)

MONTH.	DISCHARGE IN SECOND-FEET.		RUN-OFF		RAINFALL.
	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
July	12·3	·41	·47	756	
August	2·8	·09	·10	172	
September	1·3	·04	·04	77	
October	1·2	·04	·05	74	
November	1·3	·04	·04	77	
December	0·4	·01	·01	25	
The period					12

NOTE.—Stations were not established till after the spring freshet. Run-off is slightly under the influence of artificial control on Hefferly lake.

Accuracy "B."

MONTHLY DISCHARGE of Hefferly Creek, below Hefferly Lake, for 1912.

(Drainage area, 30 square miles.)

MONTH.	DISCHARGE IN SECOND-FEET.		RUN-OFF.		RAINFALL.
	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	34·5	1·15	1·33	2,121	
June	13·3	·44	·49	791	
July	4·7	·16	·18	289	
August	6·5	·22	·25	400	
The period					14

NOTE.—See note on 1911 sheet.
Accuracy "B."

DAILY GAUGE HEIGHT AND DISCHARGE of

DAY.	JUNE.		JULY.		AUGUST.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·35	8·0	0·9	2·0
2			1·35	8·0	0·85	1·6
3			1·38	7·4	0·85	1·6
4			1·3	7·2	0·85	1·6
5			1·35	8·0	0·85	1·6
6			1·3	7·2		1·6
7			1·3	7·2	0·85	1·6
8			1·3	7·2	0·85	1·6
9			1·25	6·5	0·8	1·2
10			1·25	6·5	0·8	1·2
11			1·22	6·0	0·8	1·2
12			1·2	5·7	0·8	1·2
13			1·2	5·7	0·75	1·0
14			1·17	5·2	0·75	1·0
15			1·15	5·0	0·7	0·9
16			1·07	3·9	0·7	0·9
17			1·02	5·3	0·7	0·9
18			1·0	3·0	0·65	0·6
19			1·0	3·0	0·65	0·6
20			1·0	3·0	0	0
21			1·0	3·0	0	0
22			1·0	3·0		
23			1·0	3·0		
24			1·0	3·0		
25			0·95	2·5		
26	1·4	8·7	0·95	2·5		
27	1·5	7·2	0·95	2·5		
28	1·3	7·2	0·9	2·0		
29	1·3	7·2	0·9	2·0		
30	1·35	8·0	0·9	2·0		
31			0·9	2·0		

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Anderson Diversion, from Hat Creek, for 1911.

September.		October.		November.		December.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
0	0	0·7	0·9	0·7	0·9	0·75	1·0	1
0	0	0·7	0·9	0·7	0·9	0·75	1·0	2
0	0	.....	0·9	0·7	0·9	0·75	1·0	3
0	0	0·7	0·9	0·7	0·9	0·75	1·0	4
0	0	0·7	0·9	0·75	1·0	0·75	1·0	5
0	0	0·7	0·9	0·8	1·2	0·75	1·0	6
0	0	0·7	0·9	0·8	1·2	0·75	1·0	7
0	0	0·7	0·9	0·8	1·2	0·75	1·0	8
0·7	0·9	0·7	0·9	0·8	1·2	0·7	0·9	9
0·7	0·9	0·7	0·9	0·75	1·0	.....	.....	10
0·7	0·9	0·7	0·9	0·7	0·9	.....	.....	11
0·7	0·9	0·7	0·9	0·7	0·9	.....	.....	12
0·7	0·9	0·7	0·9	0	0	.....	.....	13
.....	0·9	0·7	0·9	0	0	.....	.....	14
.....	1·0	0·7	0·9	0	0	.....	.....	15
0·75	1·0	0·7	0·9	0	0	.....	.....	16
0·75	1·0	0·7	0·9	.....	.....	.....	.....	17
0·7	0·9	0·7	0·9	.....	.....	.....	.....	18
0·7	0·9	0·7	0·9	0·75	1·0	.....	.....	19
0·7	0·9	0·7	0·9	0·75	1·0	.....	.....	20
0·7	0·9	0·7	0·9	0·75	1·0	.....	.....	21
0·7	0·9	0·7	0·9	0·75	1·0	.....	.....	22
0·7	0·9	0·7	0·9	0·75	1·0	.....	.....	23
0·7	0·9	0·7	0·9	0·75	1·0	.....	.....	24
0·7	0·9	.....	0·9	0·75	1·0	.....	.....	25
0·7	0·9	0·7	0·9	0·75	1·0	.....	.....	26
0·7	0·9	0·7	0·9	0·75	1·0	.....	.....	27
0·7	0·9	0·7	0·9	0·7	0·9	.....	.....	28
0·7	0·9	0·7	0·9	0·7	0·9	.....	.....	29
0·7	0·9	0·7	0·9	0·7	0·9	.....	.....	30
.....	.....	0·7	0·9	.....	.....	.....	.....	31

DAILY GAUGE HEIGHT AND DISCHARGE of Anderson Diversion from Hat Creek, for 1912.

Day	April.		May.		June.		July.		August.		September	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1					1·2	5·7	1·0	3·0	0·85	1·6	0·9	2·0
2			0·65	0·8	1·15	5·0	1·2	5·7	0·85	1·6	0·9	2·0
3			0·55	0·6	1·2	5·7	1·4	8·7	0·85	1·6	0·9	2·0
4			0·5	0·5	1·2	5·7	1·4	8·7	0·85	1·6	0·9	2·0
5			0·5	0·5	1·2	5·7	1·3	7·2	1·0	3·0	0·85	1·6
6			0·55	0·6	1·2	5·7	1·1	4·3	1·1	4·3	0·85	1·6
7			0·6	0·7	1·2	5·7	1·0	3·0	1·1	4·3	0·85	1·6
8			0·7	0·9	1·1	4·3	0·95	2·5	1·1	4·3	0·8	1·2
9			0·7	0·9	1·22	6·0	1·0	3·0	1·15	5·0	0·8	1·2
10			0·9	2·0	1·17	5·3	0·95	2·5	1·2	5·7	0·8	1·2
11			0·9	2·0	1·1	4·3	0·95	2·5	1·2	5·7	0·75	1·0
12	0·3	0·1	0·9	2·0	1·1	4·3	0·9	2·0	1·2	5·7	0·75	1·0
13	0·3	0·1	1·0	3·0	1·1	4·3	0·9	2·0	1·2	5·7	0·75	1·0
14	0·3	0·1	1·05	3·6	1·35	8·0	0·9	2·0	1·2	5·7	0·75	1·0
15	0·3	0·1	0·0	0·0	1·35	8·0	0·9	2·0	1·15	5·0	0·75	1·0
16	0·3	0·1	1·1	4·3	1·3	7·2	0·85	1·6	1·2	5·7	0·75	1·0
17	0·3	0·1	0·9	2·0	1·3	7·2	0·85	1·6	1·2	5·7	0·75	1·0
18	0·3	0·1	1·2	5·7	1·25	6·5	0·85	1·6	1·2	5·7	0·75	1·0
19			1·2	5·7	1·25	6·5	0·85	1·6	1·15	5·0	0·7	0·9
20			1·15	5·0	1·25	6·5	0·85	1·6	1·15	5·0	0·7	0·9
21			1·1	4·3	1·3	7·2	0·9	2·0	1·15	5·0	0·7	0·9
22			1·1	4·3	1·3	7·2	0·95	2·5	1·15	5·0		
23			1·2	5·7	1·3	7·2	0·9	2·0	1·15	5·0		
24			1·25	6·5	1·3	7·2	0·9	2·0	1·15	5·0		
25			0·9	2·0	1·3	7·2	0·9	2·0	1·1	4·3		
26			1·2	5·7	1·3	7·2	0·9	2·0	1·1	4·3		
27			1·2	5·7	1·3	7·2	0·9	2·0	1·1	4·3		
28			1·2	5·7	1·3	7·2	0·9	2·0	1·1	4·3		
29			1·2	5·7	1·1	4·3	0·9	2·0	0·85	1·6		
30			1·1	4·3	1·05	3·6	0·9	2·0	0·7	0·9		
31			1·2	5·7			0·9	2·0	0·9	2·0		

SESSIONAL PAPER No. 25f

DAILY GAUGE HEIGHT AND DISCHARGE of Crawshaw's Ditch, Hat Creek, for 1911.

Day.	JUNE.		JULY.		AUGUST.		SEPTEMBER.	
	Guage height.	Discharge.	Guage height.	Discharge.	Guage height.	Discharge.	Guage height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·4	2·6	0·25	1·4	0·1	0·4
2			0·4	2·6	0·25	1·4		0·5
3			0·4	2·6	0·25	1·4		0·6
4			0·4	2·6	0·25	1·4	0·15	0·7
5			0·4	2·6		1·4	0·15	0·7
6			0·42	2·8		1·4	0·1	0·4
7			0·32	2·0		1·4	0·1	0·4
8			0·2	1·0		1·4	0·1	0·4
9				1·0		1·4		
10			0·2	1·0	0·25	1·4		
11			0·2	1·0		1·1		
12			0·2	1·0		0·8		
13			0·2	1·0		0·6		
14			0·2	1·0	0·1	0·4		
15				0·9		0·0		
16			0·15	0·7		0·0		
17			0·15	0·7				
18			0·27	1·6				
19				2·1	0·1	0·3		
20			0·4	2·6	0·1	0·4		
21				2·3		0·9		
22				2·0	0·25	1·4		
23			0·3	1·8	0·25	1·4		
24			0·3	1·8	0·25	1·4		
25				1·8	0·25	1·4		
26	0·2	1·0		1·8	0·22	1·2		
27	0·22	1·2	0·3	1·8	0·15	0·7		
28	0·3	1·8	0·3	1·8	0·15	0·7		
29	0·4	2·6	0·25	1·4	0·15	0·7		
30	0·4	2·6		1·4	0·12	0·5		
31			0·25	1·4	0·1	0·4		

DAILY GAUGE HEIGHT AND DISCHARGE of Crawshaw's Ditch, Hat Creek, for 1912.

Day.	MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	.....	.....	2·0	0·15	0·7	.....	.....	.....	1·6
2	.....	.....	0·3	1·8	0·2	1·0	.....	.....	0·4	2·6
3	.....	.....	0·2	1·0	0·25	1·4	.....	.....	0·1	0·4
4	.....	.....	0·5	3·5	0·3	1·8	.....	.....	0·1	0·4
5	.....	.....	0·4	2·6	0·25	1·4	.....	.....	0·1	0·4
6	.....	.....	0·45	3·0	0·25	1·4	0·2	1·0	0·1	0·4
7	.....	.....	0·45	3·0	0·1	0·4	.....	1·0	0·1	0·4
8	.....	.....	0·35	2·2	0·02	0·1	0·2	1·0	0·1	0·4
9	.....	.....	0·4	2·6	0·0	0·0	.....	1·2	0·1	0·4
10	.....	.....	0·37	2·4	.....	.....	0·25	1·4	0·05	0·2
11	.....	.....	0·3	1·8	.....	.....	0·25	1·4	0·0	.....
12	.....	.....	0·3	1·8	.....	.....	0·25	1·4	.....	.....
13	.....	.....	0·25	1·4	.....	.....	0·25	1·4	.....	.....
14	.....	.....	0·0	0·0	.....	.....	0·25	1·4	.....	.....
15	.....	.....	0·0	0·0	.....	.....	0·25	1·4	.....	.....
16	0·35	2·2	0·4	2·6	.....	.....	0·25	1·4	.....	.....
17	0·35	2·2	0·4	2·6	.....	.....	0·25	1·4	.....	.....
18	0·3	1·8	0·4	2·6	.....	.....	0·25	1·4	.....	.....
19	.....	1·6	0·35	2·2	.....	.....	0·25	1·4	.....	.....
20	0·25	1·4	0·35	2·2	.....	.....	.....	1·2	.....	.....
21	0·35	2·2	0·4	2·6	.....	.....	0·2	1·0	.....	.....
22	0·35	2·2	0·4	2·6	.....	.....	0·2	1·0	.....	.....
23	0·35	2·2	0·4	2·6	.....	.....	0·2	1·0	.....	.....
24	.....	2·8	0·4	2·6	.....	.....	0·2	1·0	.....	.....
25	0·5	3·5	0·45	3·0	.....	.....	.....	0·9	.....	.....
26	0·5	3·5	0·4	2·6	.....	.....	0·15	0·7	.....	.....
27	0·3	1·8	0·4	2·6	.....	.....	0·15	0·7	.....	.....
28	0·45	3·0	0·4	2·6	.....	.....	0·15	0·7	.....	.....
29	0·4	2·6	0·25	1·4	.....	.....	0·4	2·6	.....	.....
30	.....	2·4	0·2	1·0	.....	.....	0·15	0·7	.....	.....
31	0·35	2·2	.....	.....	.....	.....	0·15	0·7	.....	.....

HORSETHIEF CREEK.

Horsethief creek is a stream about 25 miles long, which rises in the Selkirk mountains at an elevation of from 6,000 feet to 9,000 feet. It flows in an easterly direction, and discharges into Upper Columbia river at an elevation of 2,700 feet, 4 miles below lake Windermere. Near the mouth, Horsethief creek is from 50 feet to 200 feet wide, and from 2 feet to 6 feet deep, with a mean velocity of from 1 foot to 5 feet per second. The tributaries in ascending order from the mouth are: Eight-mile creek, Boulder creek, Law creek, Taylor creek and Gopher creek, all discharging from the left. The drainage area of Horsethief creek, as measured from a provincial map (1911) with a scale of 8 miles to an inch, is 170 square miles. The precipitation varies from about 14 inches at the mouth to over 50 inches at the source. The winters are long and particularly cold near the source. The summers are hot and, near the mouth, dry.

The Columbia River Irrigated Fruitlands Co. hold large irrigated records on Horsethief creek. Logging is being extensively carried on by the Columbia River Lumber Co. The logs are driven down Horsethief creek into the Columbia, and down the Columbia for 100 miles to the mill at Golden.

There are power possibilities on Horsethief creek. Immediately above the measuring section (1 mile from the mouth) there is a canyon 6 miles long. In 2½ miles the water in the canyon falls 180 feet, and in 6 miles there is a fall of 765 feet (measured by aneroid). At the head of the canyon a series of falls gives a head of 32 feet. Above the falls, Horsethief creek flows through a flat country, sparsely timbered. Any installation would be expensive, as the flow of Horsethief creek, except in June, July and August, does not average over 100 c.f.s. The winters are severe, and frazil ice has to be contended with.

During the freshet in June, July and August, Horsethief creek discharges large deposits of silt into the Upper Columbia. Shifting bars are continually formed at the two mouths of the stream, causing possibly the largest inconvenience to navigation on the Upper Columbia. The big freshet is also of interest on account of the proposal to reclaim some 50,000 acres of overflow land in the Upper Columbia valley.

Horsethief Creek.

The station on Horsethief creek was established May 29, 1912, by H. C. Hughes. Measurements were made from the downstream side of the highway bridge, Wilmer to Forsters, about one mile from the mouth of the stream. A standard vertical staff gauge, 7 feet long is nailed to the cribbing on the left bank of the stream beneath the above-mentioned bridge. Measurements are made with the meter, using from 6½ to 15 pounds of lead, suspended by a cable. The initial point for sounding is at the right abutment on the lower side of the bridge. The channel above and below the station is straight for about 100 feet and the water is very swift. All the water flows through the bridge abutments except at high water, when there is a small side channel flowing to the left of the bridge. The river at the section is shallow and the bed is very rough, causing an uneven velocity. Due to this factor, the accuracy is decreased.

Discharge Measurements of Horsethief Creek, near mouth, 1912.

Date.	Hydrographer.	Meter No.	Width	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 29	H. C. Hughes	1055	90	130	3·8	1·70	484
June 13	"	1055	95	220	5·3	2·00	1,180
July 3	"	1055	107	225	5·2	1·90	1,170
Sept. 28	C. E. Richardson	1055	61	120	2·1	1·22	250

DAILY GAUGE HEIGHT AND DISCHARGE of Horsethief Creek, at mouth, for 1912.

Day.	May.		June.		July.		August.		September.		October.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·7	700	2·1	1,400	2·3	1,850	1·6	575	1·3	300
2			1·6	575	2·3	1,850	2·2	1,620	1·6	575	1·3	300
3			1·7	700	2·1	1,400	2·2	1,620	1·6	575	1·4	375
4			1·5	465	2·1	1,400	2·1	1,400	1·6	575	1·4	375
5			1·6	575	2·0	1,200	2·2	1,620	1·6	575	1·3	300
6			1·6	575	1·9	1,000	2·0	1,200	1·6	575	1·2	240
7			1·8	850	1·9	1,000	2·1	1,400	1·5	465	1·2	240
8			1·9	1,000	2·0	1,200	2·0	1,200	1·6	575	1·3	300
9			1·9	1,000	2·0	1,200	2·0	1,200	1·6	575	1·2	240
10			1·8	850	2·1	1,400	1·9	1,000	1·5	465	1·3	300
11			1·8	850	2·0	1,200	1·9	1,000	1·6	575	1·2	240
12			2·0	1,200	1·9	1,000	1·8	850	1·5	465	1·1	190
13			2·0	1,200	1·9	1,000	1·8	850	1·6	575	1·2	240
14			1·9	1,000	2·0	1,200	1·8	850	1·5	465	1·1	190
15			1·8	850	1·9	1,000	1·8	850	1·6	575	1·0	150
16			1·7	700	1·9	1,000	1·7	700	1·6	575	1·0	150
17			1·8	850	2·0	1,200	1·7	700	1·7	700	1·0	150
18			1·9	1,000	2·1	1,400	1·7	700	1·6	575	1·0	150
19			1·9	1,000	1·9	1,000	1·9	1,000	1·6	575	1·0	150
20			2·0	1,200	2·0	1,200	1·9	1,000	1·6	575	0·9	120
21			2·2	1,620	1·9	1,000	2·6	2,620	1·6	575	0·9	120
22			2·4	2,100	2·1	1,400	2·7	2,880	1·5	465	0·8	95
23			2·7	2,880	2·0	1,200	3·1	3,950	1·5	465	0·8	95
24			3·0	3,680	2·0	1,200	3·0	3,680	1·4	375	0·8	95
25			2·9	2,420	2·0	1,200	2·9	3,420	1·5	465	0·7	75
26			3·0	3,680	2·0	1,200	2·6	2,620	1·4	375	0·7	75
27			2·8	3,150	1·9	1,000	2·3	1,850	1·5	465	0·7	75
28			2·9	3,420	2·1	1,400	2·0	1,200	1·4	375	0·6	65
29	1·7	700	2·4	2,100	2·0	1,200	1·9	1,000	1·4	375	0·6	65
30	1·8	850	2·2	1,320	2·1	1,400	1·8	850	1·3	300	0·6	65
31	1·6	575			2·3	1,850	1·7	700			0·6	65
											Freeze-up.	

MONTHLY DISCHARGE of Horsethief Creek, at mouth, for June to October, 1912.

(Drainage area, 170 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
June	3,680	465	1,490	8·8	9·8	89·000
July	1,850	1,000	1,240	7·3	8·4	6,000
August	3,950	700	1,530	9·0	10·4	94,000
September	700	300	510	3·0	3·3	30,600
October	375	65	180	1·1	1·3	11,100

NOTE.—Freeze-up occurred October 30, 1912.
Accuracy "C."

Illecillewaet River (406).

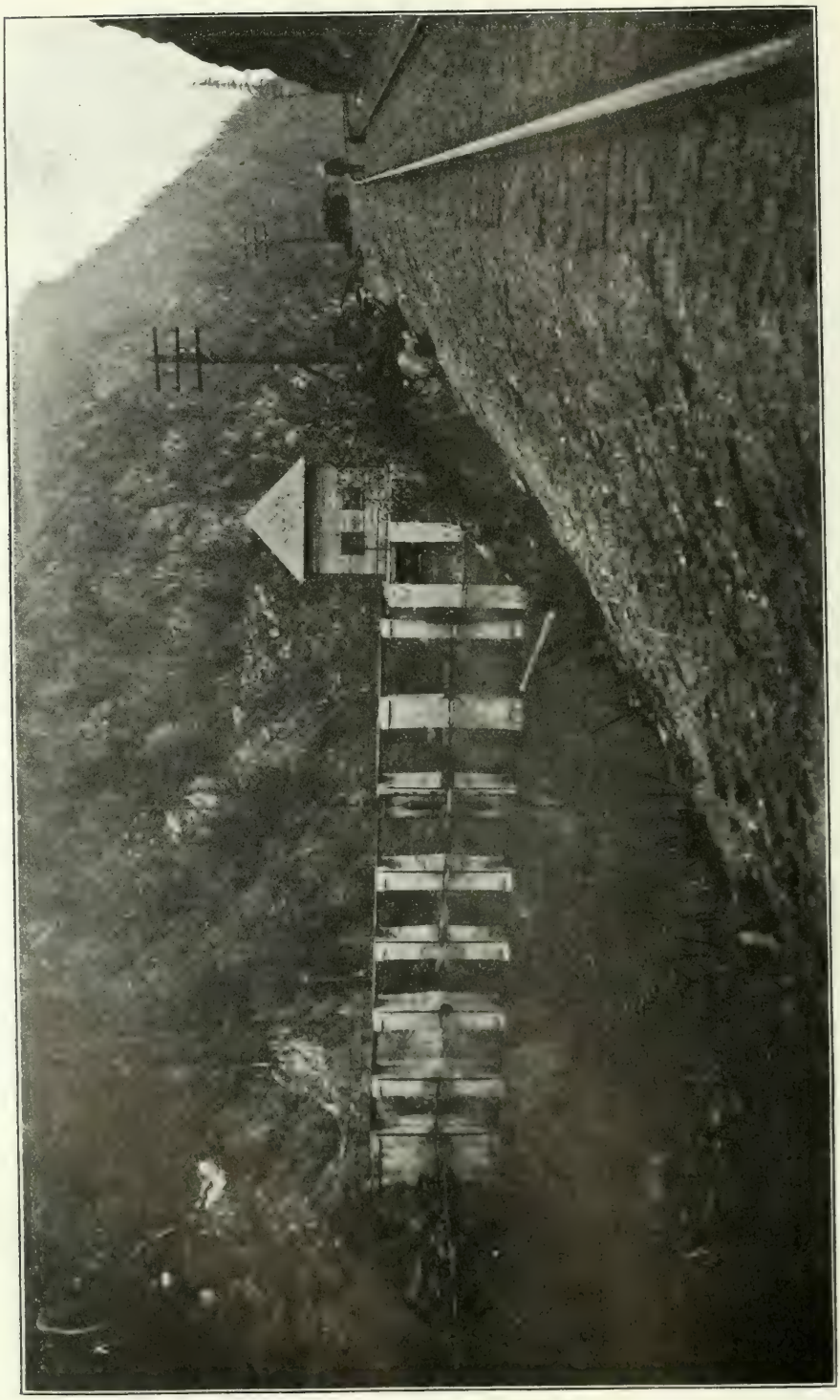
Illecillewaet river has its source in the Illecillewaet névé, at an elevation of 8,000 feet, and flowing in a southwesterly direction, discharges into Columbia river near Revelstoke, at an elevation of 1,800 feet. It is part of the Columbia drainage; the drainage area, as measured from a Dominion sectional map, scale 3 miles to an inch, is 480 square miles, of which area 140 square miles is above Albert canyon. The precipitation varies from 40 inches, at the mouth, to 100 inches at the source; the winters are very severe (–50 F.) with a tremendous snowfall (30 feet). The summers are hot and wet.

It is a typical mountain stream, and flows through a series of canyons and flats. The summer flow of the stream is very large, and rises and falls during the day to the extent of 1·5 ft. The maximum flow near the mouth occurred, in 1912, on June 23, and 9,060 c.f.s. was the mean flow for that day. The mean flow for June, July and August was 4,350 c.f.s. The flow during January, February and March was very small, and averaged not over 250 c.f.s. The control above the gauging station, from which these discharges were obtained, is artificial, being influenced by the Revelstoke Power Co.'s dam.

Power developments have been installed on this river at Revelstoke and at Glacier. At Revelstoke, a head of 73 feet is obtained by a concrete dam, 50 feet high and 45 feet wide, and a flume 200 yards long. A development of 750 horse-power is used to light the city of Revelstoke. At Glacier, the C.P.R. installed a small plant to light the 'Glacier House' (tourists' hotel); a head of 60 feet is used, and about 100 horse-power is developed. There are other possible developments on this stream, in Albert Canyon gorge and in the Box canyon, 3 miles above Revelstoke. In all developments on this stream, frazil ice must be contended with; also, slides during the winter hold back the water as long as forty-eight hours, and then the rush of water carries with it gravel, logs, etc. There are no natural reservoirs on the stream, and the C.P.R. running along its bank prohibits any large artificial storage.

There are at present no other interests on this stream. Valuable timber may be found anywhere in the Illecillewaet drainage, especially along the North Fork. A large mining syndicate operated on the North Fork several years ago, but is not now in existence. The scenic beauty of the Illecillewaet valley is known to the thousands of tourists who yearly pass over the main line of the C.P.R.

The river station was established October 13, 1911, by C. E. Richardson. The measuring section is located on the lower traffic bridge, one mile and a half from Revelstoke, and three-quarters of a mile from the mouth of the river. Cable measurements are made from the downstream side of the bridge. A chain gauge, 26·8 feet long, is used, and the graduations are painted on the handrail on the upstream side of the traffic bridge near Moran's house. The measuring section is excellent; the control is good, the current uniform, the channel straight, with a permanent bed, and the banks are not liable to overflow except at very high water, when some water might flow through a side channel, 100 yards to the left of the bridge.



Revelstoke Light and Power Company's Dam on Illecillewaet River.

Revelstoke Light and Power Company's Pipe Line.

DISCHARGE MEASUREMENTS of Illecillewaet River, near Revelstoke, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
1911.							
Oct. 13....	C. E. Richardson.....	1048	140	480	1·4	1·52*	370
1912.							
Feb. 24.....	"	1047	130	220	0·9	0·7	197
June 20.....	"	1048	144	890	7·4	6·6	6,610
June 24.....	"	1048	145	960	7·8	6·9	7,510
July 3.....	"	1048	142	735	5·6	5·6	4,100
Aug. 20.....	"	1048	133	580	4·0	4·3	2,320
Sept. 14.....	"	1048	128	514	3·4	3·82	1,750
Oct. 4.....	"	1055	128	498	2·2	3·0	1,080
Nov. 2.....	"	1044	128	460	1·5	2·9	690

*Gauge and all bench-marks were destroyed on January 2, 1912.

DAILY GAUGE HEIGHT AND DISCHARGE of Illecillewaet River, near Revelstoke, for 1911.

Day.	October.		November.		December.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·86	391	1·86	391
2			1·89	401	1·65	332
3			1·91	408	1·65	332
4			1·70	344	1·66	354
5			1·90	404	1·76	361
6			1·90	404	1·70	344
7			1·90	404	1·70	344
8			2·0	440	1·71	347
9			1·91	408	1·74	355
10			1·62	325	1·75	358
11			1·62	325	1·60	320
12			1·59	318	1·65	332
13	2·52	671	1·89	401	1·69	342
14	2·86	890	1·90	404	1·65	332
15	2·55	688	1·95	422	1·62	325
16	2·50	660	2·39	605	1·62	325
17	2·4	610	2·4	610	1·70	344
18	2·3	563	2·44	630	1·70	344
19	2·25	541	2·41	615	1·72	350
20	1·82	378	1·95	422	1·78	366
21	2·4	610	1·94	418	1·64	330
22	2·18	510	1·91	408	1·61	322
23	2·1	478	1·89	401	1·60	320
24	2·1	478	1·71	347	1·60	320
25	2·1	478	1·75	358	1·59	318
26	2·0	440	1·72	350		
27	2·02	448	1·94	418		
28	2·01	444	2·15	498		
29	1·91	408	2·12	486		
30	1·98	433	2·06	469		
31	1·94	418				

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MONTHLY DISCHARGE of Illecillewaet River, near Revelstoke, for 1911.

(Drainage area, 480 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage. area.	Total in acre-feet.	Inches.
October	890	378	637	1·3	1·5	39,200	
November	630	318	428	0·9	1·0	25,500	
December	391	300	332	0·7	0·8	20,400	
The period							40 to 70

NOTE.—On January 1, 1912, gauge and all bench-marks were destroyed by bridge gang. On the 1912 discharge table, 669 c.f.s. is equivalent to 2·52 on the new gauge. The two gauges are in practically the same section and although the section has been changed slightly by the new bridge piers the control is unaltered By adding 1·2 to 1911 gauge heights and using the 1912 discharge table the 1911 discharges have been correctly deduced.

Accuracy, "B" and "C."

DAILY GAUGE HEIGHT AND DISCHARGE

Day.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	.....	3·05	1,040	.....	.....	5·3	3,610	5·6	4,120
2	.....	.....	3·05	1,040	.....	.....	5·2	3,450	5·75	4,400
3	.....	.....	3·1	1,080	.....	.....	5·4	3,770	5·3	3,610
4	.....	.....	3·25	1,210	.....	.....	5·3	3,610	6·3	5,610
5	.....	.....	3·4	1,340	.....	.....	5·75	4,400	6·1	5,120
6	.....	.....	3·45	1,380	.....	.....	5·7	4,300	5·0	3,160
7	.....	.....	3·6	1,530	.....	.....	5·35	3,690	5·1	3,300
8	.....	.....	4·4	2,400	.....	.....	5·35	3,690	5·0	3,160
9	.....	.....	4·45	2,460	.....	.....	5·35	3,690	5·8	4,490
10	.....	.....	4·75	2,830	.....	.....	5·3	3,610	5·2	3,450
11	.....	.....	4·55	2,580	.....	.....	5·35	3,690	5·4	3,770
12	.....	.....	4·7	2,760	.....	.....	5·35	3,690	4·95	3,090
13	.....	.....	4·95	3,090	.....	.....	6·35	5,750	4·75	2,830
14	.....	.....	5·45	3,860	.....	.....	5·25	3,530	4·9	3,020
15	.....	.....	6·05	5,010	.....	.....	5·6	4,120	5·15	3,380
16	.....	.....	6·2	5,350	.....	.....	5·3	3,610	4·7	2,760
17	.....	.....	5·7	4,300	.....	.....	5·4	3,770	5·1	3,300
18	.....	.....	5·0	3,160	.....	.....	5·1	3,300	4·15	2,120
19	2·4	610	4·95	3,090	6·65	6,660	5·8	4,490	4·3	2,280
20	2·45	635	5·4	3,770	6·95	7,770	5·75	4,390	4·7	2,760
21	2·7	778	5·45	3,860	7·25	9,060	5·4	3,770	5·35	3,690
22	2·75	812	5·55	4,030	7·05	8,180	5·3	3,610	5·6	4,120
23	3·15	1,120	5·55	4,030	7·25	9,060	5·15	3,380	5·5	3,940
24	3·15	1,120	5·55	4,030	6·9	7,570	5·0	3,160	6·65	6,660
25	3·05	1,040	5·6	4,120	6·85	7,380	5·55	4,030	5·9	4,690
26	2·9	920	5·95	4,800	7·0	7,970	5·3	3,610	5·1	3,300
27	2·95	960	5·95	4,800	7·0	7,970	5·0	3,160	5·4	3,770
28	2·90	920	5·4	3,770	6·05	5,010	5·2	3,450	4·45	2,460
29	3·0	1,000	5·0	3,160	5·35	3,690	5·5	3,940	4·25	2,230
30	3·05	1,040	6·9	7,570	5·1	3,300	5·65	4,210	4·05	2,010
31	.....	.....	.....	6,000	.....	.....	5·3	3,610	3·8	1,730

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of Illecillewaet River, near Revelstoke, for 1912.

September.		October.		November.		December.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
3·85	1,780	3·0	1,000	2·5	660	2·30	563	1
3·75	1,680	2·95	960	2·55	688	2·30	563	2
3·9	1,840	3·3	1,250	2·55	688	2·25	541	3
3·7	1,630	3·25	1,210	2·5	660	2·40	610	4
3·7	1,630	3·0	1,000	2·55	688	2·30	563	5
3·55	1,480	2·95	960	2·55	688	2·30	563	6
3·7	1,630	2·80	850	2·55	688	2·30	563	7
3·85	1,780	2·85	880	2·55	688	2·30	563	8
3·85	1,780	2·8	850	2·5	660	2·30	563	9
3·85	1,780	2·85	880	2·4	610	2·30	563	10
4·05	2,010	2·75	810	2·4	610	2·25	541	11
4·25	2,230	2·7	780	2·4	610	2·25	541	12
4·05	2,010	2·7	780	2·45	635	2·30	563	13
3·75	1,680	2·65	750	2·5	660	2·30	563	14
3·55	1,480	2·7	780	2·5	660	2·30	563	15
3·5	1,430	2·85	880	2·4	610	2·20	519	16
3·4	1,340	3·7	1,630	2·4	610	2·20	519	17
3·5	1,430	3·35	1,300	2·4	610	2·20	519	18
3·3	1,250	3·1	1,080	2·45	635	2·15	498	19
3·2	1,170	3·05	1,040	2·6	716	2·15	498	20
3·2	1,170	3·35	1,300	2·75	813	2·10	478	21
3·2	1,170	3·5	1,430	2·6	716	2·10	478	22
3·2	1,170	2·90	920	2·55	688	2·05	459	23
3·2	1,170	2·75	810	2·65	747	2·05	459	24
3·0	1,000	2·8	850	2·45	635	2·10	478	25
2·95	960	2·8	850	2·40	610	2·10	478	26
2·85	880	2·8	850	2·40	610	2·15	498	27
2·8	850	2·6	720	2·40	610	2·20	519	28
2·8	850	2·5	660	2·40	610	2·15	498	29
2·75	810	2·6	720	2·40	610	2·05	459	30
		2·5	660			2·05	459	31

MONTHLY DISCHARGE of Illecillewaet River, near Revelstoke, for 1912.

(Drainage area, 480 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	7,570	1,040	3,340	7·0	8·1	205,000	
June	9,060	3,300	5,790	12·1	13·5	344,000	
July	5,750	3,160	3,810	8·0	9·2	234,000	
August	6,660	1,730	3,490	7·3	8·4	215,000	
September	2,230	810	1,440	3·0	3·3	85,700	
October	1,630	660	950	2·0	2·3	58,400	
November	812	610	657	1·4	1·6	39,100	
December	610	459	524	1·1	1·3	32,200	
The period							80

NOTE.—Winter conditions existed during January and February. The discharge is partially controlled by the dam of the city of Revelstoke Power Company.
Accuracy, "A," "B" and "C."

INGRAM CREEK (300).

Ingram creek rises in the Bouleau hills just south of Grand Prairie, at an elevation of about 4,000 feet, and flows into Salmon river in township 17, range 13, west of the 6th meridian, 3 miles east of Grand Prairie village, at an elevation of about 1,880 feet. The creek is about 9 miles long, and drains an area of 25 square miles. The drainage area is a broken plateau extending southerly from the bowl-shaped Grand Prairie to the Bouleau hills, which separate Ingram creek and Salmon river from the Okanagan divide. About seven miles from the mouth of Ingram creek there is a meadow, called Homfray's meadow, which could be used as a reservoir in which to store the surplus waters of the May floods. At Homfray's meadow the creek has an abrupt turn from the east, and about a mile from this turn the creek divides into two forks. On the north fork there are two meadows, which might be suitable for storage reservoirs. These are Wolf's and Johnston's meadows. On account of improvements on Wolf's meadow, or homestead, Johnston's meadow might be the only site available for storage, unless the economic value of the stored water in Homfray's and Wolf's meadows for use in the valuable Grand Prairie lands be considered greater than the said meadows for actual cultivation.

The mean annual precipitation in Grand Prairie and the Ingram drainage is about 12 inches. Irrigation is necessary, and the waters of Ingram creek are extremely valuable for irrigation purposes. Some of the water is now used on the Ingram estate and neighbouring lands at the mouth of the stream, but by far the greater proportion of the flood waters of May and June run to waste into Salmon river.

There are some six old provincial water records from Ingram creek, the first one (dated 1871) being appurtenant to the Ingram estate, and practically controls the natural flow of the stream during the latter part of the irrigation season.

The run-off of Ingram creek has been studied during the open season of 1911 and 1912. A station was established a short distance above the mouth and all irrigation diversions. Meter measurements were taken, and daily records of gauge heights. The resulting hydrographic data for the periods, April 1 to September 30, 1911, and

April 1 to September 1, 1912, are appended. The year 1911 was a dry year throughout nearly the whole Dry Belt. The maximum discharge of Ingram creek took place on May 17, 1911, and was 52 cubic feet per second (gauge height, 1·64 feet). The minimum flow occurred September 19, and was 0·5 c.f.s. with a gauge height of 0·3 feet. The total run-off from April 1 to September 30 was a little over 3,000 acre-feet. The flow prior to April 1, and later than September 30 was very small, being less than 1 c.f.s.

The year 1912 had a much larger run-off. The maximum discharge took place again on May 17, and was 130 c.f.s., with a gauge height of 2·15 feet. The minimum recorded stage was on August 9, being 3·0 c.f.s., and the gauge height of 0·65 feet. The total run-off from April 1 to September 1, 1912, was 7,000 acre-feet.

A river station was established on Ingram creek, May 24, 1911, by C. E. Richardson. The measuring section is located half a mile from the Armstrong-Grand Prairie road, 3 miles from the latter town, and 25 feet above King's diversion. This is an excellent section—the water is swift, the control good, the banks not liable to overflow, and there is only one channel, with a permanent rocky bed. The measurements are made by wading. A standard staff gauge was located on the right bank 200 yards above the King or Ingram diversion. On May 16, 1912, this gauge was washed out by the floods, and a similar gauge was located on the left bank, directly opposite the position of the former gauge. Both gauges were referred to the same three bench-marks.

DISCHARGE MEASUREMENTS of Ingram Creek, near Grand Prairie, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 24	C. E. Richardson	1048	18·0	20·3	1·9	1·51	38·2
May 24	C. G. Cline	1046	18·0	19·6	1·8	1·51	36·5
June 16	W. M. Carlyle	1044	15·0	8·2	1·0	1·01	7·9
July 12	"	1044	14·0	9·2	0·6	0·90	5·9
July 26	"	1044	7·0	2·9	0·9	0·62	2·7
Aug. 23	"	1044	5·0	2·0	0·7	0·46	1·5
1912.							
May 11	C. E. Richardson	1048	18·0	18·5	3·1	1·68	57·0
July 16	"	1048	5·0	4·7	1·3	0·82	6·0

DAILY GAUGE HEIGHT AND DISCHARGE of

Day.	APRIL.		MAY.		JUNE.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		1·0		15	1·3	17
2		1·0		18	1·3	17
3		1·0		20	1·4	25
4		2·0		22	1·3	17
5		2·0		24	1·2	12·7
6		2·0		25	1·2	12·7
7		2·0		24	1·2	12·7
8		3·0		24	1·2	12·7
9		3·0		23	1·1	10
10		3·0		23	1·3	17
11		3·0		23	1·1	10
12		3·0		23	1·1	10
13		4·0		23	1·05	8·8
14		4·0		24	1·0	7·6
15		4·0		24	1·0	7·6
16		5·0		38	0·98	7·3
17		5·0		52	0·98	7·3
18		5·0		49	0·95	6·7
19		6·0		45	0·95	6·7
20		6·0		42	0·9	5·8
21		7·0		38	0·98	7·3
22		8·0		38	1·05	8·8
23		9·0		37	1·0	7·6
24		10	1·51	37	1·0	10
25		10	1·4	25	1·1	8·8
26		10	1·4	25	1·05	8·8
27		11	1·4	25	1·05	8·8
28		12	1·4	25	1·0	7·6
29		12	1·3	17	0·98	7·3
30		13	1·3	17	0·98	6·7
31			1·3	17		

Ingram Creek, near Grand Prairie, for 1911.

July.		August.		September.		October.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
0·95	6·7	0·5	1·7	0·4	1·1	0·4	1·0	1
0·9	5·8	0·48	1·6	0·42	1·2	0·35	0·8	2
0·88	5·6	0·48	1·6	0·41	1·1	0·35	0·8	3
0·85	5·1	0·4	1·1	0·41	1·1	0·4	1·0	4
0·8	4·4	0·55	2·1	0·41	1·1			5
0·8	4·4	0·58	2·3	0·41	1·1			6
1·1	10·0	0·65	2·9	0·41	1·1			7
1·2	12·7	0·65	2·9	0·41	1·1			8
1·2	12·7	0·65	2·9	0·4	1·1			9
1·15	11·3	0·6	2·4	0·4	1·1			10
1·1	10·0	0·58	2·3	0·4	1·1			11
1·0	7·6	0·55	2·1	0·45	1·4			12
0·9	5·8	0·55	2·1	0·5	1·7			13
0·88	5·6	0·55	2·1	0·45	1·4			14
0·85	5·1	0·5	2·1	0·45	1·4			15
0·7	3·3	0·5	1·7	0·45	1·4			16
0·78	4·2	0·55	2·1	0·4	1·1			17
0·75	3·9	0·5	1·7	0·35	0·8			18
0·75	3·9	0·45	1·4	0·3	0·5			19
0·68	3·1	0·45	1·4	0·35	0·8			20
0·65	2·9	0·45	1·4	0·4	1·1			21
0·65	2·9	0·48	1·6	0·4	1·1			22
0·65	2·9	0·45	1·4	0·35	0·8			23
0·60	2·4	0·45	1·4	0·35	0·8			24
0·60	2·4	0·45	1·4	0·3	0·5			25
0·58	2·3	0·42	1·2	0·35	0·8			26
0·55	2·1	0·52	1·9	0·35	0·8			27
0·55	2·1	0·52	1·9	0·4	1·1			28
0·55	2·1	0·5	1·7	0·4	1·1			29
0·52	1·8	0·5	1·7	0·45	1·4			30
0·5	1·7	0·42	1·2					31

MONTHLY DISCHARGE of Ingram Creek, near Grand Prairie, for irrigation season, 1911.

(Drainage area, 25 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	13	1	5·5	0·2	0·22	333	
May	52	15	28	1·1	1·27	1,666	
June	25	5·8	10·4	0·42	0·47	619	
July	12·7	1·7	5·0	0·2	0·23	298	
August	2·9	1·1	1·8	0·07	0·08	107	
September	1·7	0·5	1·1	0·04	0·04	65	
October			1·5				
November			1·5				
December			1·5				
The period							12

NOTE.—The estimated mean flow for the months of October, November and December, is 1·5 c.f.s. Accuracy, "A."

DAILY GAUGE HEIGHT AND DISCHARGE of Ingram Creek, near Grand Prairie, for 1912.

Day.	April.		May.		June.		July.		August.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	0·65	3·0	1·6	47	1·35	23	0·95	7·1	0·75	4·2
2	0·65	3·0	1·6	47	1·35	23	1·0	8·0	0·7	3·6
3	0·7	3·6	1·6	47	1·25	17·3	1·05	9·3	0·7	3·6
4	0·7	3·6	1·65	53	1·25	17·3	1·05	9·3	0·7	3·6
5	0·7	3·6	1·7	60	1·2	14·7	1·0	8·0	0·7	3·6
6	0·75	4·2	1·7	60	1·15	12·7	1·05	9·3	0·7	3·6
7	0·75	4·2	1·75	67	1·15	12·7	1·05	9·3	0·7	3·6
8	0·8	4·8	1·8	74	1·1	10·7	1·0	8·0	0·7	3·6
9	0·8	4·8	1·75	67	1·1	10·7	1·0	8·0	0·65	3·0
10	0·8	4·8	1·75	67	1·05	9·3	0·95	7·1	0·65	3·0
11	0·82	5·2	1·8	74	1·1	10·7	0·95	7·1	0·65	3·0
12	0·85	5·5	1·85	82	1·15	12·7	1·0	8·0	0·65	3·0
13	0·95	7·1	1·9	90	1·2	14·7	1·0	8·0	0·65	3·0
14	1·2	14·7	1·95	97	1·25	17·3	0·95	7·1	0·7	3·6
15	1·4	27	2·0	105	1·35	23	0·9	6·3	0·7	3·6
16	1·2	14·7	2·05	112	1·45	31	0·9	6·3	0·7	3·6
17	1·2	14·7	2·15	130	1·45	31	0·85	5·5	0·75	4·2
18	1·3	20	2·15	130	1·4	27	0·85	5·5	0·7	3·6
19	1·3	20	2·05	112	1·35	23	0·8	4·8	0·65	3·0
20	1·4	27	2·05	112	1·25	17·3	0·8	4·8	0·65	3·0
21	1·5	36	1·95	97	1·2	14·7	0·75	4·2	0·65	3·0
22	1·6	47	1·85	82	1·15	12·7	0·75	4·2	0·65	3·0
23	1·55	41	1·8	74	1·05	9·3	0·75	4·2	0·65	3·0
24	1·65	53	1·8	74	0·95	7·1	0·75	4·2	0·65	3·0
25	1·6	47	1·75	67	0·95	7·1	0·75	4·2	0·65	3·0
26	1·55	41	1·65	53	0·9	6·3	0·7	3·6	0·65	3·0
27	1·45	31	1·6	47	0·9	6·3	0·7	3·6	0·65	3·0
28	1·4	27	1·6	47	0·95	7·1	0·7	3·6	0·65	3·0
29	1·5	36	1·45	31	0·95	7·1	0·75	4·2	0·65	3·0
30	1·55	41	1·4	27	1·0	8·0	0·8	4·8	0·65	3·0
31			1·4	27			0·75	4·2	0·65	3·0

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MONTHLY DISCHARGE of Ingram Creek, near Grand Prairie, for Irrigation Season 1912.

(Drainage area, 25 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	53	3	19·8	0·8	0·9	1,178	
May	130	27	72·9	2·9	3·34	4,482	
June	31	6·3	14·8	0·6	0·67	881	
July	9·3	3·6	6·2	0·25	0·29	369	
August	4·2	3·0	3·3	0·13	0·15	203	
September			3				
October			2				
November			2				
December			2				
The period							15

NOTE.—The estimated mean flow for September is 3 c.f.s. For the remaining six winter months, it is about 2 c.f.s. Severe winter conditions exist generally from December to March.

Accuracy, "A" and "B."

JACKO CREEK (231).

Jacko creek has its source in the hills, 20 miles south of Kamloops, at an elevation of 3,800 feet, and discharges into Jacko lake near Kamloops, at an elevation of 2,200 feet. It is part of the Peterson-South Thompson drainage. The drainage area, as measured from the Geological Survey map, dated 1895, scale 2 miles to an inch, is 13 square miles. Three small unnamed creeks enter from the right going upstream. Jacko creek is a small but very contentious irrigation stream in the most arid section of the Dry Belt. The summers are hot and dry, the winters long and cold (–30° F.)

Jacko creek, rising in a swamp, descends rapidly for about 6 miles through a densely wooded country, where it flows sluggishly through irrigable land to Jacko lake. The water in Jacko creek is subject to the records on Jacko lake and Peterson creek, of which it is the chief tributary. (See Peterson creek for further information.) In 1911 and for the preceding four years, no water reached Jacko lake; this fact formed the basis of bitter fights in the courts. From the observation made in 1912, it appears that there is an enormous loss of water due to seepage. With a discharge of 7 second-feet at the gauging station, there was no more than 2 second-feet lower down, all the irrigation ditches being closed.

The river station on Jacko creek was established above all diversions on May 1, 1912, by H. J. E. Keys. The measuring section is located about 100 feet above the Watson diversion, and 100 yards west of the Kamloops-Trout Lake road. A standard vertical staff gauge is located on the right bank at the measuring section. All measurements were made by wading. This is an excellent measuring section, with good control, high banks, uniform current and one permanent channel. The datum of the gauge is referred to one bench-mark.

DISCHARGE MEASUREMENTS of Jacko Creek, 12 miles south of Kamloops, 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 18	H. J. E. Keys	1057	7·0	6·2	1·2	2·00	7·2
May 29	" "	1057	5·0	5·0	0·6	1·80	3·2
July 16	" "	1057	3·0	1·2	0·5	1·42	0·5

DAILY GAUGE HEIGHT AND DISCHARGE of Jacko Creek, 12 miles south of Kamloops, for 1912.

Day.	MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	1·7	2·3	1·7	2·3	1·3	0·15	0	0·10	.....	0·50
2	.....	2·9	.....	1·9	.....	0·50	1·2	0·05	1·5	0·85
3	1·8	3·4	1·6	1·5	1·5	0·85	.....	0·35	.....	1·20
4	.....	3·4	.....	1·5	.....	1·05	.....	0·60	1·6	1·5
5	.....	3·4	1·6	1·5	.....	1·25	1·5	0·85	.....	1·5
6	1·8	3·4	.....	1·3	1·6	1·50	.....	0·60	.....	1·5
7	.....	4·1	.....	1·1	.....	1·50	1·4	0·35	1·6	1·5
8	1·9	4·9	1·5	0·85	1·6	1·50	.....	0·25	.....	1·20
9	.....	5·6	.....	0·60	.....	1·20	.....	0·15	1·5	0·85
10	.....	6·3	1·4	0·35	1·5	0·85	1·2	0·05	.....	0·60
11	2·0	7·1	.....	0·35	.....	0·70	.....	0·10	1·4	0·35
12	.....	8·8	1·4	0·35	.....	0·50	1·3	0·15	.....	0·25
13	2·1	10·5	.....	0·70	1·4	0·35	.....	0·10	.....	0·20
14	.....	12·1	.....	1·05	.....	0·20	1·0	0·0	1·3	0·15
15	.....	13·7	1·6	1·50	1·0	0·0	.....	0·50	.....	0·15
16	2·2	15·3	.....	1·20	.....	0·0	.....	1·00	1·3	0·15
17	.....	11·2	1·5	0·85	0·9	0·0	1·6	1·50	.....	0·10
18	2·0	7·1	.....	0·60	.....	0·0	.....	1·50	.....	0·10
19	.....	6·0	1·4	0·35	.....	0·0	1·6	1·50	1·2	0·05
20	1·9	4·9	.....	0·35	.....	0·0	.....	1·20	.....	0·05
21	.....	4·9	.....	0·35	.....	0·05	1·5	0·85	1·2	0·05
22	1·9	4·9	1·4	0·35	1·2	0·05	.....	0·60	.....	0·10
23	.....	4·9	.....	0·25	.....	0·45	.....	0·40	1·3	0·15
24	.....	4·9	1·3	0·15	1·5	0·85	1·3	0·15	.....	0·10
25	1·9	4·9	.....	0·15	.....	1·05	.....	0·15	.....	0·10
26	.....	4·2	1·3	0·15	.....	1·25	1·3	0·15	1·2	0·05
27	1·8	3·4	.....	0·15	1·6	1·50	.....	0·15	.....	0·05
28	.....	3·4	.....	0·15	.....	1·20	1·3	0·15	.....	0·05
29	1·8	3·4	1·3	0·15	1·5	0·85	.....	0·15	.....	0·05
30	.....	2·8	.....	0·15	.....	0·50	.....	0·15	.....	0·05
31	1·7	2·3	.....	.....	1·3	0·15	1·3	0·15	.....	.....

MONTHLY DISCHARGE of Jacko Creek, 12 miles south of Kamloops, for 1912.

(Drainage area, 13 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	15·3	2·3	5·8	0·45	0·52	357	
June	2·3	0·15	0·74	0·06	0·06	44	
July	1·5	0·0	0·65	0·05	0·06	40	
August	1·5	0·0	0·45	0·03	0·04	28	
September	1·5	0·05	0·44	0·03	0·03	26	
The period							12

NOTE.—In 1911 four weeks, readings were obtained in June and July, at which time the creek dried up. These readings were taken on a gauge two miles below the present gauge, and only one measurement was obtained.

Accuracy, "B."

JAMIESON CREEK (232 AND 233).

Jamieson creek has its source in the hills north of Tranquille Forest reserve, outside the Railway Belt, at an elevation of 5,000 feet. It discharges into North Thompson river from the west, 18 miles north of Kamloops, at an elevation of 1,170 feet. It is part of the North Thompson drainage. The area of the watershed is 66 square miles. The creek is in the Dry Belt and the water is used for irrigation. The mean annual precipitation is from 10 to 12 inches. Owing to the influence of the valley of North Thompson river, the climate is a little cooler than at Kamloops, and the snow remains on the ground much longer in the winter.

The water of Jamieson creek is used by the British Columbia Fruitlands Company for the irrigation of their lands along North Thompson and Thompson rivers. The intake is situated about a mile from the mouth of the creek. Water has to be used from Jamieson creek for this purpose for a number of years, but a new canal and flume line has recently been constructed by the company to replace the old system. The canal is lined with concrete to prevent seepage. Where necessary, galvanized steel fluming has been used and one inverted siphon of 48 inches diameter has been constructed of wood stave pipe. The main system is about 15 miles long, and will serve some 6,000 acres of the company's land. The British Columbia Fruitlands Company have constructed a storage dam on Wentworth lake, near the head of the creek, but small storage has been secured.

The main station on Jamieson creek (232) is 100 feet above the British Columbia Fruitlands dam, and measures the total flow of the stream. It was established June 20, 1911, and gauge readings were taken till October 31, 1911, and from April 3 to October 31, 1912. The gauge is a 5 foot cedar staff nailed to a tree stump on the left bank of the stream, 100 feet above the British Columbia Fruitlands Company's dam. Its datum is referred to three permanent bench-marks. The meter measurements were made by wading at a section 25 feet below the gauge. The channel is straight for 25 feet above the section, and the water swift. There is a straight channel with riffles, for 75 feet below the section, when the dam is reached. The right bank is a rock cliff, 100 feet high. The left bank is 3 feet high and covered with bushes, but is not very likely to overflow. There is a gravel bar in the bed itself which, at a certain stage,

divides the creek into two branches near the gauge. This occurs at a gauge height of 3·0 for a range of about 0·6 feet. Above that stage the water flows over the bar and, below that stage, the second stream stops running. The gauge is only about 100 feet above the dam, and although there is considerable fall in that distance, the engineer should note particularly each trip that no change has been made at the dam to affect the height of the water at the gauge, and that there are still riffles between the gauge and the dam.

A second station (233) was established below the dam to show the amount of unused water, and to give some idea of the water diverted by the British Columbia Fruitlands ditch. It was found, however, that there was considerable loss by seepage from the stream into the gravel beds between the two stations. Hence, the amount of unused water is larger than the figures given by lower station; the amount of water diverted cannot be found by comparing the surface flow at the two stations. Gauge readings were taken at the lower station, from June 22, 1911 (when the station was established), to October 30, 1911, and from April 3 to July 12, 1912. The gauge readings at this station will not be continued another season.

DISCHARGE MEASUREMENTS of Jamieson Creek, below British Columbia Fruitlands Diversion, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
June 21	C. G. Cline	1046	22	32·8	0·9	1·77	28·9
Oct. 7	Cline and Smith	1046	8	3·8	0·4	1·09	1·4
1912.							
May 10	E. M. Dann	1044	30	57	6·0	3·20	*343
June 5	Dann and Keys	1044	18	37	1·5	2·00	57
June 21	H. J. E. Keys	1057	9	8	1·1	1·43	8·7
July 8	"	1057	18	33	1·0	1·80	30

* Bridge measurement.

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DAILY GAUGE HEIGHT AND DISCHARGE of Jamieson Creek, below British Columbia Fruitlands Diversion, for 1911.

Day.	June.		July.		August.		September.		October.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1.			1·5	11·5			1·0	0·1	1·25	3·5
2.			1·5	11·5			0·9	0·0	1·25	3·5
3.			1·45	9·5	creek dry.		1·0	0·1	1·25	3·5
4.			1·35	6·0			1·0	0·1	1·2	2·5
5.			1·2	2·5			1·0	0·1	1·2	2·5
6.			1·2	2·5	0·6	0·0	0·9	0·0	1·2	2·5
7.			1·15	1·5	1·0	0·1	0·8	0·0	1·15	1·5
8.			1·2	2·5	0·6	0·0	0·7	0·0	1·15	1·5
9.			1·45	9·5	0·5	0·0	0·8	0·0	1·15	1·5
10.			1·4	7·5	0·4	0·0	0·9	0·0	1·15	1·5
11.			1·3	4·5	0·3	0·0	0·75	0·0	1·2	2·5
12.			1·3	4·5	0·5	0·0	0·65	0·0	1·2	2·5
13.			1·2	2·5	0·7	0·0	0·65	0·0	1·15	1·5
14.			1·1	0·5	0·6	0·0	0·6	0·0	1·15	1·5
15.			1·0	0·0	0·4	0·0	1·45	9·5	1·25	3·5
16.			1·0	0·0	0·2	0·0	1·45	9·5	1·25	3·5
17.			0·9	0·0	0·0	.....	1·45	9·5	1·2	2·5
18.			0·6	0·0	0·1	creek	1·5	11·5	1·2	2·5
19.			0·3	0·0	0	dry.	1·45	9·5	1·15	1·5
20.			0·0	0·0	0	.....	1·4	7·5	1·15	1·5
21.			1·5	11·5	0	.....	1·4	7·5	1·15	1·5
22.	1·7	23	0·9	0·0	0	.....	1·25	3·5	1·15	1·5
23.	1·95	48	.....	.....	0	.....	1·15	1·5	1·15	1·5
24.	2·0	55	.....	.....	0·6	.....	1·15	1·5	1·1	0·5
25.	1·6	16	.....	.....	0·8	.....	1·15	1·5	1·1	0·5
26.	1·6	16	creek		0·9	.....	1·15	1·5	1·1	0·5
27.	1·6	16	dry.		1·0	0·1	1·25	3·5	1·1	0·5
28.	1·55	14	.....	.....	1·0	0·1	1·15	1·5	1·1	0·5
29.	1·5	11·5			1·0	0·1	1·1	0·5	1·1	0·5
30.	1·5	11·5			1·0	0·1	1·1	0·5	1·1	0·5
31.	.....	.....	.....	.....	0·9	.....	.....	.....	.....	.....

MONTHLY DISCHARGE of Jamieson Creek, below British Columbia Fruitlands Diversion, for 1911.

(Drainage area, 66 square miles.)

Month.	Discharge in Second-Feet.				Run Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
July	11·5	0	2·8	·04	·05	172	
August	0·1	0	0·2	·00	·0	0·1	
September	11·5	0	2·7	·04	0·4	161	
October	3·5	0·5	1·8	·03	·03	111	
The period							12 to 15

NOTE.—Accuracy, "A."

DAILY GAUGE HEIGHT AND DISCHARGE of Jamieson Creek, below British Columbia Fruitlands Diversion, for 1912.

Day.	April.		May.		June.		July.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	2·5	2·3	104	2·4	124	1·1	0·5
2	.....	2·5	2·4	124	2·3	104	1·2	2·5
3	1·2	2·5	2·5	145	2·2	86	1·2	2·5
4	1·2	2·5	2·6	167	2·1	70	1·0	0·1
5	1·2	2·5	2·6	167	2·0	55	1·2	2·5
6	1·2	2·5	2·7	192	1·8	32	1·2	2·5
7	1·3	4·5	2·8	220	1·8	32	1·4	7·5
8	1·2	2·5	3·1	310	1·8	32	1·5	11·5
9	1·4	7·5	3·2	343	1·8	32	1·6	16·0
10	1·4	7·5	3·3	376	1·8	32	1·6	16·0
11	1·4	7·5	3·3	376	1·8	32	1·4	7·5
12	1·4	7·5	3·3	276	1·8	32	1·2	2·5
13	1·4	7·5	3·4	410	1·8	32	.....	.....
14	1·4	7·5	3·5	445	1·9	42	.....	.....
15	1·6	16·0	3·7	515	2·0	55	.....	.....
16	1·6	16·0	3·7	515	1·9	42	.....	.....
17	1·8	32·0	3·5	445	1·8	32	.....	.....
18	1·7	25·0	3·5	445	1·7	23	.....	.....
19	1·8	32·0	3·4	410	1·6	1·6	.....	.....
20	1·8	32·0	3·5	445	1·5	11·5	.....	.....
21	1·8	32·0	3·6	480	1·3	4·5	.....	.....
22	1·8	32·0	3·5	445	1·3	4·5	.....	.....
23	1·8	32·0	3·4	410	1·1	0·5	.....	.....
24	1·7	23·0	3·1	310	1·0	0·1	.....	.....
25	1·9	42·0	3·1	310	1·0	0·1	.....	.....
26	1·9	42·0	3·0	278	.....	.....	.....	.....
27	2·0	55·0	3·1	310	.....	.....	.....	.....
28	2·0	55·0	2·9	248	.....	.....	.....	.....
29	2·1	70·0	2·7	192	.....	.....	.....	.....
30	2·3	104·0	2·6	167	.....	.....	.....	.....
31	.....	.....	2·5	145	.....	.....	.....	.....

MONTHLY DISCHARGE of Jamieson Creek, below British Columbia Fruitlands Diversion, for 1912.

(Drainage area, 66 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	104	2·5	23·5	0·4	0·4	1,398	
May	515	104	317	4·8	5·5	19,500	
June	124	0	30·9	0·5	0·6	1,838	
The period							12

NOTE.—This station is unimportant and the same weight should not be given to these discharges as to those of the upper station.
Accuracy, "B."

DISCHARGE MEASUREMENTS of Jamieson Creek, above British Columbia Fruitlands Diversion, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
June 20	C. G. Cline	1046	24	28	2·2	2·35	61
Aug. 20	"	1046	19	13	0·6	1·78	8·4
Oct. 7	"	1046	20	15	0·5	1·82	7·6
1912.							
May 10	E. M. Dann	1046				3·60	354*
June 5	"	1046				2·50	85*
June 21	H. J. E. Keys	1057				2·30	58*
July 8	"	1057	23	31	1·8	2·33	56

* Discharge computed by adding discharge of diversions to discharge at lower station.

DAILY GAUGE HEIGHT AND DISCHARGE of Jamieson Creek, above British Columbia Fruitlands Diversion, for 1911.

Day.	JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.	
	Gauge heignt.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			2·35	62	1·9	12	1·7	3	1·95	16
2			2·2	40	1·85	10	2·4	69	1·95	16
3			2·25	34	1·85	10	2·2	40	1·95	16
4			2·15	34	1·8	7	2·2	40	1·95	16
5			2·1	28	1·8	7	2·2	40	1·95	16
6			2·1	28	2·0	19	2·2	40	1·9	12
7			2·15	34	2·3	54	2·2	40	1·9	12
8			2·2	40	2·3	54	2·2	40	1·9	12
9			2·4	69	2·25	47	2·2	40	1·9	12
10			2·3	54	2·4	69	2·2	40	1·9	12
11			2·25	47	2·3	54	2·15	34	1·9	12
12			2·25	47	2·3	54	2·3	54	1·9	12
13			2·2	40	2·2	40	2·2	40	1·9	12
14			2·15	34	2·2	40	2·15	34	1·9	12
15			2·1	28	2·1	28	2·15	34	2·05	24
16			2·1	28	2·0	19	2·1	28	2·1	28
17			2·05	24	2·0	19	2·1	28	2·1	28
18			2·1	28	2·0	1·9	2·1	28	2·0	19
19			2·05	24	1·9	12	2·1	28	2·0	19
20			2·1	28	1·85	10	2·1	28	1·9	12
21			2·1	28	1·85	10	2·1	28	1·9	12
22	1·9	12	2·1	28	1·8	7	2·05	24	1·9	12
23	2·25	47	2·0	19	1·8	7	2·05	24	1·9	12
24	2·3	54	1·9	12	1·75	5	2·0	19	1·9	12
25	1·95	16	1·9	12	1·75	5	2·0	19	1·9	12
26	2·25	47	1·9	12	1·7	3	2·0	19	1·9	12
27	2·35	62	1·9	12	1·75	5	1·95	16	1·9	12
28	2·35	62	1·9	12	1·7	3	1·95	16	1·9	12
29	2·3	54	1·9	12	1·7	3	1·9	12	1·9	12
30	2·25	47	1·9	12	1·7	3	1·9	12	1·9	12
31			1·9	12	1·7	3				

SESSIONAL PAPER No. 25f

MONTHLY DISCHARGE of Jamieson Creek, above British Columbia Fruitlands Diversion, for 1911.

(Drainage area, 65 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage. area.	Total in acre-feet.	Inches.
July	69	12	29·7	0·46	0·53	1,830	
August	69	3	20·6	0·32	0·37	1,270	
September	69	3	30·6	0·47	0·52	1,820	
October	28	12	14·6	0·22	0·25	898	
The period							12

NOTE.—Station was established June 22, artificial control.
Accuracy, "B."

Daily Gauge Height and Discharge of Jamieson

Day.	April.		May.		June.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			2·7	122	2·8	143
2			2·8	143	2·8	143
3	1·4	0	2·9	166	2·7	122
4	1·4	0	3·0	190	2·6	103
5	1·4	0	3·0	190	2·5	85
6	1·4	0	3·1	215	2·5	85
7	1·7	3	3·2	240	2·5	85
8	1·7	3	3·5	325	2·5	85
9	1·8	7	3·6	350	2·5	85
10	1·8	7	3·7	380	2·5	85
11	2·0	19	3·7	380	2·5	85
12	2·0	19	3·7	380	2·5	85
13	2·0	19	3·8	410	2·6	103
14	1·8	7	3·9	440	2·6	103
15	2·0	19	4·1	500	2·7	122
16	2·0	19	4·1	500	2·6	103
17	2·2	40	3·9	440	2·5	85
18	2·1	28	2·9	440	2·5	85
19	2·2	40	3·8	410	2·3	54
20	2·2	40	3·9	440	2·3	54
21	2·3	54	4·0	470	2·2	40
22	2·3	54	3·9	440	2·2	40
23	2·3	54	3·8	410	2·2	40
24	2·4	69	3·5	325	2·2	40
25	2·5	85	3·5	325	2·1	28
26	2·5	85	3·4	295	2·1	28
27	2·6	103	3·5	325	2·2	40
28	2·6	103	3·3	265	2·2	40
29	2·7	122	3·1	215	2·2	40
30	2·8	143	3·0	190	2·3	54
31			2·9	166		

SESSIONAL PAPER No. 25f

Creek, above British Columbia Fruitlands Diversion, for 1912.

July.		August.		September.		October.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
2·5	85	2·4	69	2·4	69	2·0	19	1
2·6	103	2·3	54	2·6	103	2·0	19	2
2·6	103	2·3	54	2·5	85	2·0	19	3
2·4	69	2·2	40	2·5	85	1·9	12	4
2·4	69	2·2	40	2·4	69	1·9	12	5
2·4	69	2·2	40	2·4	69	2·0	19	6
2·4	69	2·0	19	2·2	40	2·0	19	7
2·3	54	1·9	12	2·6	103	2·0	19	8
2·3	54	2·0	19	2·8	143	2·1	28	9
2·3	54	2·0	19	2·6	103	2·1	28	10
2·2	40	2·0	19	2·5	85	2·1	28	11
2·2	40	2·0	19	2·4	69	2·1	28	12
2·2	40	1·9	12	2·4	69	2·1	28	13
2·2	40	1·9	12	2·4	69	2·1	28	14
2·2	40	2·0	19	2·3	54	2·1	28	15
2·2	40	2·1	28	2·3	54	2·1	28	16
2·2	40	2·6	103	2·3	54	2·2	40	17
2·2	40	2·8	143	2·3	54	2·3	54	18
2·1	28	2·6	103	2·3	54	2·3	54	19
2·0	19	2·5	85	2·3	54	2·2	40	20
1·9	12	2·4	69	2·3	54	2·2	40	21
2·8	143	2·2	40	2·3	54	2·3	54	22
3·0	190	2·2	40	2·2	40	2·2	40	23
3·0	190	2·0	19	2·2	40	2·2	40	24
3·0	190	2·0	19	2·1	28	2·3	54	25
2·9	166	2·0	19	2·1	28	2·4	69	26
2·8	143	1·9	12	2·1	28	2·3	54	27
2·6	103	2·1	28	2·1	28	2·3	54	28
2·4	69	2·2	40	2·1	28	2·3	54	29
2·4	69	2·2	40	2·0	19	2·3	54	30
2·2	40	2·3	54			2·3	54	31

MONTHLY DISCHARGE of Jamieson Creek, above British Columbia Fruitlands Diversion, for 1912.

(Drainage area, 65 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	143	0·0	38·0	0·58	0·65	2,261	
May	500	122	325	5·0	5·8	20,000	
June	143	28	76·3	1·2	1·3	4,540	
July	190	12	77·8	1·2	1·4	4,780	
August	143	12	41·6	0·64	0·74	2,560	
September	143	19	61·1	0·94	1·0	3,640	
October	54	12	36·0	0·56	0·64	2,210	
The period							14

NOTE.—Artificial control.
Accuracy, "B."

The following float measurements of the discharge of Jamieson creek are published by the courtesy of Mr. Arthur Meighan, C.E., engineer of the British Columbia Fruitlands Company, who made them during the seasons of 1907, 1908 and 1909. Measured at Headgates (C.P.R. ditch).

Date.	Sec.-feet.
1907.	
April 13	4·2
" 20	3·5
" 29	18·3
May 8	247·7
" 13	268·8
" 19	315·9
" 19 (p.m.)	1,400 (cloud burst)
" 20	315·9
" 28	414·5
June 5	294·9
" 19	176·0
" 21	143·6
" 23	143·6
" 24	71·3
July 21	34·9
" 27	33
Aug. 3	18·7
" 9	15
" 12	29
" 17	58 (rain)
" 18	76·8
" 21	46
" 24	38
" 27	27
" 31	22·5
1908.	
April 10	4
" 17	5·7
" 20	10
" 21	41

Date.	Sec.-feet.
1908.	
April 22	67
" 24	72
" 26	80
" 28	80
" 29	71
May 1	103·7
" 2	206 (rain)
" 5	220
" 6	284
" 8	480
" 16	583
June 4	380
" 6	360
" 7	336
" 9	225
" 10	232
" 11	156
" 12	125
" 13	125
" 14	111
" 16	93
" 18	96 (rain)
" 19	140
" 21	113
" 23	113
" 25	72
" 26	77
" 28	132
" 30	102
July 3	63
" 5	47
" 6	47

Date.	Sec.-feet.	Date.	Sec.-feet.
1908.		1909.	
July 12	43	June 12	134
" 16	40	" 13	120
" 22	29	" 14	98
" 31	25	" 15	86
Aug. 14	20	" 17	70
" 30	10	" 20	50
1909.		" 23	rain
		" 24	"
		" 25	140
April 4	6	" 26	135 rain
May 1	6	" 27	150
" 4	22	" 28	140
" 5	22	" 30	130
" 6	18	July 1	119
" 8	25	" 2	110
" 11	46	" 3	80
" 12	53	" 6	50
" 13	71	" 7	heavy rain
" 14	81	" 8	100
" 15	91	" 10	85
" 16	83	" 12	rain
" 17	100	" 17	"
" 21	112	" 20	100
" 22	117	" 25	50 rain
" 23	120	" 26	rain
" 24	202	" 27	65
" 26	452	" 31	45
" 27	452	Aug. 2	40
" 31	354	" 5	40
June 1	404	" 8	42
" 2	621 rain)	" 11	40
" 3	453	" 15	37
" 5	308	" 17	35
" 6	243	" 18	30
" 7	186	" 20	25
" 8	186	" 23	20
" 10	150	" 31	10
" 11	134		

Jones Lake and Creek (1250).

Jones creek rises in Jones lake, which is situated in the northwesterly part of township 3, range 27, west of the 6th meridian, and which is at an elevation of 1,950 feet. The creek discharges into Fraser river near Ruby creek in section 19, township 4, range 27, at an elevation of 100 feet. It is part of the Fraser drainage. Boulder creek enters from the east just below Jones lake. The area of the watershed above the outlet of the lake is 10 square miles. The water is not used at present, but it is proposed to use it for the development of power. Careful hydrographic studies have been made at Jones lake during 1911 and 1912 by Anderson and Warden, civil engineers, Vancouver, acting for the Vancouver Power Co. They give the precipitation for the year period from April 1, 1911 to April 1, 1912, as 77 inches. They established a gauging station on Jones creek at the outlet from Jones lake and another on Boulder creek near the mouth, and regular gauge readings have been taken since March 24, 1910.

Jones lake is situated in a valley high up in the spur of the Cheam mountains, east and north of the town of Chilliwack, and about seven miles east of Agassiz. The waters flow in a northerly direction for about 6 miles, discharging into Fraser river.

The drainage area of 40 square miles lies mostly above the 3,000-foot level, and some of the surrounding mountains are 8,000 feet high. The land near the lake is covered with an inferior growth of timber, mostly of spruce and cedar. The ravines and gullies have a thick growth of fern and devil's club.

The area of Jones lake is 1,263 acres. The shores of the lake rise abruptly from the water, except where small creeks enter; here there are to be found low flats and swamps. At the 50-foot contour, the area of the lake or reservoir would be about 2,300 acres.

The construction of six-mile pipe line down Jones Creek valley to the Fraser would be very expensive, and the maintenance of such a construction would be difficult. The development proposed by the Vancouver Power Co. is by means of a tunnel from the lake at its most westerly point, extending through the mountains to the Fraser valley. This tunnel would be 10,200 feet long, and from its outlet to the power-house the water would be conveyed in pressure pipes, 6,000 feet long. In this way an effective head of 1,800 feet would be obtained.

The records of run-off by Messrs. Anderson and Warden show a mean flow of about 160 cubic feet per second.

Kicking Horse River (410-412).

Kicking Horse river rises in Wapta lake near the Kicking Horse pass, at an elevation of 5,200 feet. It flows in a general westerly direction for about 45 miles, and empties into Columbia river at Golden. Its main tributaries are (in ascending order from the mouth): Glenogle creek, Porcupine creek, Beaverfoot river, Otterhead river, Ottertail river, Amiskwi river, Emerald river, Yoho river, Cathedral creek and Sherbrooke creek. Of these, the Yoho river has by far the greatest maximum discharge.

Kicking Horse river drains an area of 700 square miles of very mountainous country. The river is mostly glacial-fed, with a large run-off in June, July and August, and a small discharge in the winter.

The precipitation varies from 14 inches in the Columbia valley at the mouth to over 70 inches at its head-waters in the summit of the Rockies, particularly in the Yoho valley, where the snowfall is very large.

The summer days are hot but short, and the nights cool. The winters are cold and severe, with a temperature sometimes down to −40° F. Snow falls at all seasons on the tops of the high mountains; and generally about the middle or end of October it snows in the Kicking Horse pass, to remain all winter. The river itself freezes at night during the latter part of October, and solidly late in November, breaking only about the first week of April.

There is some valuable timber along many of the tributaries of the Kicking Horse, and the river is used a little at its lower end for log driving. There is also a little mining done on several tributaries (Cathedral and Ice rivers). Most of the Kicking Horse drainage lies within Yoho Park reserve, and the scenic beauty of the river and vicinity is well known to all who have toured the Canadian Rockies over the C.P.R.

The river flows mostly through narrow canyons and gorges, particularly in the upper and lower sections. At Field, the river runs through wide gravel flats.

There are several places where power developments are practicable.

At Kicking Horse or Wapta falls, 3 miles from Leanchoil, and about 20 miles from Golden, the direct fall is 84 feet and, with a small dam just above the falls, a head of 100 feet is available. Above the falls, the river is about 150 feet wide, the banks are steep and over 100 feet high, and there is good pondage in the flats above. A tunnel 200 yards long would be necessary through the left bank for penstock. Power site is in the valley of a small creek just below falls. No large storage is available and

anchor and frazil ice would have to be contended with, winter conditions being severe. Minimum flow is about 150 cubic feet per second; the falls are about 150 yards below the mouth of the Beaverfoot river, and the discharge is almost the same as recorded at the river station at Golden (q.v.).

Another power site is just below the Natural Bridge near Field, fall of 70 feet, with 12 more in rapids in a distance of 200 yards. There is a narrow canyon about 50 feet wide with sheer rock walls 30 feet high at the head of the canyon, and nearly 100 feet high at the foot. The power could best be developed by a diverting dam at the head of the canyon, the water being conducted by a pipe through a 20-foot cut in the left bank to a power site just below canyon. Practically no storage is obtainable. The scenic interest of the Natural Bridge must not be interfered with.

The discharge at the proposed power site is about that at the river station called Kicking Horse River at Field.

There are also several power developments possible on Kicking Horse river above the mouth of Yoho river. By pipe-line construction, heads of from 350 to 800 feet are available. Small storage could be secured in Sherbrooke and Wapta lakes. The run-off is small. See discharge data at river station called Kicking Horse river at No.2 tunnel.

Three river stations were established on Kicking Horse river: (1) At Golden (410)near the mouth, established in October, 1911; (2) Kicking Horse river at Field (411), just below the mouth of Yoho river, established in June, 1912; and (3) Kicking Horse River at No. 2 tunnel (412) just above the mouth of Yoho river, established June, 1912. A station was also established on the Yoho, but the gauge was washed out by the excessive floods in June, and was not replaced. The difference between the discharges at the two upper stations on the Kicking Horse should give the flow of the Yoho very nearly. The stations were all continued until freeze-up at the end of October.

Kicking Horse River at Golden (410).

The station was established on the Kicking Horse river at Golden on October 18, 1911, by C. E. Richardson. The measuring section is located on the downstream side of the lower traffic bridge at Golden, about 1 mile from the mouth of the river. The gauge is a vertical staff 2 inches by 4 inches by 8 feet (cedar), marked in the feet and tenths in black paint. It is fastened to a breakwater on the right side of the river (looking downstream) and on the downstream side of the bridge. Measurements were made with Price's electric current meter (small) and from 6½ to 15 pounds of lead, suspended by a cable. The initial point for sounding is at the new breakwater abutment on the right side of the bridge. The channel above and below the station is straight for 100 yards, and the water is swift. During low water the river is confined to one channel, about 5 feet deep, but during the freshet shortly above the station the water enters a side channel which, at extremely high water, is 3 feet or 4 feet deep. This channel empties into the Columbia about 150 yards above the regular mouth of the Kicking Horse. The bed of the river at the station is gravel, but not very liable to shift. There is a permanent gravel bar some 100 yards below the station. When the river is low in the winter and freezes over, anchor ice coming down the river from the rapids above catches on this bar. The water is backed up beneath the ice for one-half a mile where the river remains open, and then floods out on the surface of the ice. Through this process, the ice in February, 1912, at the station was in places 5 feet thick. The channel is about 150 feet wide, but in February, 1912, 125 feet of this 150 feet was choked with anchor ice, and the stream was flowing in a channel 25 feet wide.

During the open season conditions are suitable for accurate measurements, as the results obtained show.

The following bench-marks were located with reference to the gauge datum.

B.M. No. 1.—Head of 5-inch spike in the downstream side of the right abutment. Elevation, 6′·44.

B.M. No. 2.—Near B.M. Elevation, 7′·55.

B.M. No. 3.—Same as B.M., on upstream side of right abutment. Elevation 7′·11.

Discharge Measurements of Kicking Horse River, at Golden, B.C., 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
Oct. 18	C. Richardson	1048	35	280	1·7	1·72	464
1912.							
Feb. 22	"	1047	25	185	0·93		172
May 24	C. Richardson and H. Hughes	1055	90	130	4·3	3·46	1,840
June 4	"	1055	103	372	2·7	2·64	999
June 8	" "	1048	156	567	4·2	3·9	2,390*
June 24	"	1055	203	928	6·4	5·64	5,970*
July 26	"	1055	176	604	4·7	4·26	2,830*
Sept. 26	"	1055	99	363	2·8	2·48	1·030
Oct. 1	"	1055	100	351	2·6	2·36	930
July 12	H. C. Hughes	1055	176	654	5·2	4·6	3,340*

*Water running in side channel.

SESSIONAL PAPER No. 25f

DAILY GAUGE HEIGHT AND DISCHARGE of Kicking Horse river, at Golden, B.C., for 1911.

DAY.	OCTOBER.		NOVEMBER.	
	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·20	160
2			1·20	160
3			1·60	365
4			1·60	565
5			1·58	350
6			1·30	200
7			1·10	130
8			0·95	100
9			0·92	95
10			0·95	100
11				
12				
13				
14				
15				
16				
17				
18	1·72	450		
19	1·70	435		
20	1·70	435		
21	1·68	420		
22	1·65	400		
23	1·62	380		
24	1·65	400		
25	1·60	365		
26	1·50	295		
27	1·40	240		
28	1·38	230		
29	1·35	220		
30	1·30	200		
31	1·28	190		

DAILY GAUGE HEIGHT AND DISCHARGE

DAY.	APRIL.		MAY.		JUNE.		JULY.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·65	400	2·90	1,340	4·42	3,060
2			1·50	295	2·90	1,340	4·60	3,520
3			1·50	295	2·75	1,220	4·50	3,180
4			1·50	295	2·50	1,100	4·30	2,900
5			1·50	295	2·45	980	4·35	2,960
6			1·55	330	2·55	1,060	4·62	3,350
7			1·60	365	2·90	1,340	4·65	3,400
8			1·95	610	3·90	2,370	4·50	3,180
9	1·25	180	2·25	830	4·55	2,960	4·50	3,180
10	1·25	180	2·25	830	4·25	2,820	4·55	3,240
11	1·35	220	2·20	795	4·45	3,100	4·55	3,240
12	1·50	295	2·25	830	4·85	3,760	4·62	3,350
13	1·45	270	2·65	1,140	5·40	5,040	4·70	3,480
14	1·35	220	3·35	1,765	5·00	4,070	4·55	3,240
15	1·35	220	3·90	2,370	4·80	3,660	4·40	3,040
16	1·40	240	4·10	2,620	4·70	3,480	4·42	3,060
17	1·35	220	3·90	2,370	4·85	3,770	4·15	2,690
18	1·30	200	3·60	2,020	5·00	4,070	4·35	2,960
19	1·30	200	3·45	1,865	5·15	4,400	4·45	3,100
20	1·32	210	3·40	1,815	5·30	4,770	4·50	3,180
21	1·20	200	3·25	1,665	5·35	4,900	4·30	2,900
22	1·35	220	3·40	1,815	5·38	4,990	4·42	3,060
23	1·40	240	3·40	1,815	5·55	5,560	4·25	2,820
24	1·48	288	3·40	1,815	5·55	5,560	4·45	3,100
25	1·50	295	3·45	1,865	5·50	5,370	4·30	2,900
26	1·40	240	3·90	2,370	5·62	5,870	4·35	2,960
27	1·40	240	4·20	2,755	5·58	5,680	4·15	2,960
28	1·35	220	3·90	2,370	5·48	5,300	4·05	2,560
29	1·55	330	3·52	1,940	4·82	3,700	4·25	2,820
30	1·60	365	3·32	1,740	4·68	3,440	4·30	2,900
31			3·05	1,480			4·55	5,240

of Kicking Horse river, at Golden, B.C., for 1912.

August.		September.		October.		November.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
4·60	5,320	3·75	2,190	2·33	880	1·62	380	1
4·60	3,320	3·55	1,970	2·17	775	1·62	580	2
4·45	3,100	3·52	1,940	2·17	775	1·50	575	3
4·85	3,760	3·55	1,970	2·47	1,000	1·82	520	4
4·70	3,480	3·48	1,900	2·35	910	1·82	520	5
4·38	3,010	3·40	1,820	2·28	855	1·77	485	6
4·05	2,560	3·42	1,840	2·25	830	1·77	485	7
4·12	2,680	3·38	1,800	2·30	870	1·72	455	8
4·70	3,480	3·25	1,760	2·22	810	1·77	485	9
4·55	3,240	3·28	1,700	2·20	795	1·70	435	10
4·30	2,900	3·38	1,800	2·18	780			11
4·10	2,600	3·60	2,020	2·10	720			12
3·92	2,400	3·65	2,080	2·10	720			13
3·80	2,250	3·45	1,860	2·10	720			14
4·10	2,620	3·25	1,660	2·10	720			15
4·50	3,180	3·18	1,600	2·10	720			16
4·40	3·040	3·22	1,640	2·38	930			17
4·20	2,760	3·00	1,430	2·20	795			18
4·30	2,900	2·90	1,340	2·20	795			19
4·30	2,900	2·78	1,240	2·12	735			20
4·40	3,040	2·70	1,180	2·08	705			21
4·50	3,180	2·70	1,180	2·10	720			22
4·75	3,570	2·65	1,140	2·05	680			23
5·35	4,900	2·58	1,080	2·00	645			24
5·75	6,720	2·52	1,040	2·00	645			25
5·10	4,200	2·48	1,000	1·95	610			26
4·78	3,620	2·42	960	1·95	610			27
4·65	3,400	2·40	945	1·90	575			28
4·35	2,960	2·32	885	1·80	505			29
4·08	2,600	2·25	830	1·70	435			30
3·92	2,400			1·65	400			31

MONTHLY DISCHARGE of Kicking Horse River, at Golden, B.C., for 1912.
(Drainage area, 700 square miles.)

Month.	Discharge in Second Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	365	180	224	0·32	0·36	13,300	
May	2,760	295	1,410	2·0	2·3	86,700	
June	5,870	980	3,570	5·1	5·7	212,000	
July	3,480	2,560	2,080	4·4	5·1	189,000	
August	6,720	2,250	3,250	4·6	5·3	199,000	
September	2,190	830	1,530	2·2	2·5	91,000	
October	1,000	400	731	1·04	1·2	44,900	
The period							50

NOTE.—Freeze-up occurred in 1911 on November 11. Channel opened in 1912 on April 8. Freeze-up occurred in 1912 about the middle of November. On November 9, 1911, the discharge was 35 c.f.s. (open conditions). On February 22, 1912, the discharge was 172 c.f.s. (under ice cover). There is a possibility of an ice jam having formed in the stream about the 8th of November, 1911, above the gauge.
Accuracy, "A."

KICKING HORSE RIVER AT FIELD (411).

The station was established on Kicking Horse river at Field on June 6, 1912, by C. E. Richardson. The measuring section is located on the first traffic bridge on the Yoho road after leaving Brewster's stable, and is about 3½ miles above Field. A chain gauge of length, 13'·5 was installed on the downstream side of the above-mentioned bridge, and the rise and fall of the stream is recorded in feet and tenths on one of the beams. Measurements were made with Price's electric current meter (small) and 15 pounds of lead suspended by a cable. The initial point for sounding is the left abutment on the downstream side of the bridge. The channel above and below the station is straight for 100 yards, and the water is very fast. The river is confined between the bridge abutments at all stages. The bed of the stream is gravelly, and the depth of the water varies from 2 feet to 8 feet.

The following bench-marks were established with reference to the gauge datum:—

B.M. No. 1.—Four-inch spike in a fir tree on the left bank of the stream, 50 feet from the bridge and 20 feet below the road. Elevation, 14' ·56.

B.M. No. 2.—On a flat rock 12 feet from B.M. Elevation, 12' ·63.

B.M. No 3.—On a large rock on the left bank, 30 feet from the river and 50 feet below the road. Elevation, 11' ·70.

An idea of the amount of precipitation in the Yoho valley and Upper Kicking Horse may be obtained by comparing the run-off depth in inches obtained from this station and that obtained in Golden, where the amount of precipitation is known.

An interesting point to note is the difference in flow in the morning and evening. Kicking Horse river at the Field station varies 2,000 c.f.s. on a hot day.

Looking up from foot of Kicking Horse Canyon.

Kicking Horse River near Field, B. C.

DISCHARGE MEASUREMENTS of Kicking Horse River, at Field, B.C. 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
June 6	C. E. Richardson	1048	58	120	2·5	4·4	295
June 25	"	1048	111	403	8·9	7·0	3,600
June 26	"	1048	139	488	9·6	7·6	4,710
June 27	"	1048	105	325	8·0	6·4	2,620
July 2	"	1048	86	272	7·1	6·0	1,940
Aug. 13	"	1048	73	192	5·0	5·35	960
Oct. 2	"	1055	53	102	2·1	3·7	214
Nov. 19	"	1044	45	76	1·6	3·1	117

DAILY GAUGE HEIGHT AND DISCHARGE of Kicking Horse river, at Field, B.C., for 1912.

Day.	JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			6·0	1,940	6·45	2,670	4·95	595	3·8	200	3·2	120
2			6·1	2,100	6·45	2,670	4·8	500	3·7	185	3·2	120
3		mean.	5·8	1,620	6·6	2,930	4·7	450	3·75	192	3·2	120
4		200	5·85	1,700	6·7	3,100	4·6	405	3·8	200	3·2	120
5		)	5·95	1,860	6·45	2,670	4·55	385	3·75	192	3·2	120
6	4·40	330	5·95	1,860	5·95	1,860	4·5	365	3·7	185	3·2	120
7	4·83	518	5·85	1,700	6·05	2,020	4·5	365	3·7	185	3·2	120
8	5·13	743	5·75	1,550	6·20	2,260	4·5	365	3·7	185	3·2	120
9	5·33	960	5·9	1,780	6·45	2,670	4·5	365	3·6	170	3·2	120
10	5·38	1,030	5·8	1,620	6·25	2,340	4·55	385	3·6	170	3·2	120
11	5·53	1,230	6·05	2,020	6·05	2,020	4·7	450	3·6	170	3·2	120
12	5·83	1,670	5·9	1,780	5·85	1,700	4·9	560	3·5	155	3·2	120
13	6·28	2,380	6·0	1,940	5·75	1,550	4·85	530	3·5	155	3·2	120
14	5·78	1,600	5·55	1,260	5·95	1,860	4·65	430	3·5	155	3·2	120
15	5·63	1,370	5·9	1,780	6·05	2,020	4·6	405	3·5	155	3·2	120
16	5·73	1,520	5·9	1,780	5·95	1,860	4·6	405	3·5	155	3·2	120
17	5·93	1,830	6·0	1,940	5·65	1,400	4·45	350	3·5	155		
18	6·18	2,220	6·1	2,100	5·6	1,320	4·35	315	3·5	155		
19	6·33	2,470	6·1	2,100	5·65	1,400	4·15	265	3·5	155		
20		2,760	6·15	2,180	5·8	1,620	4·05	245	3·4	140		
21		2,920	6·05	2,020	6·0	1,940	4·05	245	3·4	140		
22		3,260	6·25	2,340	6·2	2,260	4·05	245	3·4	140		
23		3,620	6·15	2,180	6·55	2,840	3·9	215	3·4	140		
24		3,810	6·1	2,100	7·3	4,180	3·85	208	3·4	140		
25	7·2	4,000	6·05	2,020	7·05	3,720	3·8	200	3·4	140		
26	7·4	4,380	5·8	1,620	6·4	2,580	3·8	200	3·4	140		
27		3,620	5·7	1,480	6·1	2,100	3·75	192	3·4	140		
28		2,920	5·75	1,550	5·75	1,550	3·7	185	3·4	140		
29	6·2	2,260	6·15	2,180	5·4	1,050	3·7	185	3·3	130		
30		2,100	6·45	2,670	5·2	810	3·7	185	3·3	130		
31			6·50	2,760	5·05	670			3·3	130		

MONTHLY DISCHARGE of Kicking Horse river, at Field, for 1912.

(Drainage area, 130 square miles.)

Month.	Discharge in Second Feet.				Run-Off.	
	Maximum	Minimum	Mean	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
June	4,380	200	1,880	14·4	16·1	111,900
July	2,760	1,260	1,920	14·8	17·0	118,000
August	4,180	670	2,120	16·3	18·8	130,300
September	595	185	340	2·6	2·9	20,200
October	200	130	159	1·2	1·4	9,780
November	120	120	120	0·92	1·03	7,140

NOTE.—The maximum flow of 4,760 c.f.s., which took place on June 26, lasted only a few hours, the mean flow for the day being 4,380 c.f.s. Freeze-up occurred at 6 p.m. November 20, 1912. Accuracy, "A" and "B".

KICKING HORSE RIVER AT NO. 2 TUNNEL (1912).

The station on Kicking Horse river at No. 2 tunnel was established on June 28, 1912, by C. E. Richardson. The measuring section is located three-quarters of a mile above the mouth of Yoho river, 25 yards above the C.P.R. bridge between No. 1 and No. 2 tunnels, and five miles from Field via the old C.P.R. grade, which is now used as a wagon road. The gauge is a vertical staff, 2 inches by 4 inches by 7 feet (cedar), marked in feet and tenths with blue paint. It is fastened to a crib on the right bank of the stream (looking downstream) 25 yards above the C.P.R. bridge, between No. 1 and No. 2 tunnels. At low stages, measurements are made by wading, but during high water it is impossible to wade, and measurements are made by stretching across the stream an endless cable, to which a pulley is fastened. A cable on which the meter is suspended is passed through this pulley. The meter may be located at any desired point by means of the endless cable. Price's electric current meter is used in all measurements on this stream. The channel above and below the station is straight for about 50 feet. The water is swift, particularly below, where a riffle affords good control. The banks of the stream rise vertically for 5 feet, and then are gradually sloping. During high water a small side channel is formed to the left of the regular section, but the percentage of water which flows through it is very small so that it has little effect on the gauge. The bed of the stream is composed of silt and small gravel, but, due to the good control, the possibility of shifting is very small. The depth of the channel varies from 1 foot to 5 feet.

The following bench-marks were located and referred to the gauge datum:—

B.M. No. 1.—Nail in the downstream end of second log in a small shack directly across the stream from the gauge. Elevation 6′ ·19.

B.M. No. 2.—Nail driven in top of stump 20 feet to the right and below the gauge. Elevation 8′ ·80.

B.M. No. 3.—Top of right abutment on upstream side of the C.P.R. bridge, between No. 1 and No. 2 tunnels; also a C.P.R. bench-mark. Elevation 29′ ·86.

B.M. No. 3.—Elevation above sea-level, 4,635′ ·4.

Elevation of gauge datum above sea-level, 4,605′ ·54.

Discharge Measurements of Kicking Horse river, at No. 2 Tunnel, 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
June 28,	C. E. Richardson	1,048	39	110	4·0	5·0	470*
July 2	"	1,048	37	84	3·6	4·2	299
Aug. 5	"	1,048	37	94	3·9	4·45	378
Aug. 13	"	1,048	36	81	3·3	3·88	270
Oct. 2	"	1,055	30	27	2·2	2·08	60†
Nov. 19	"	1,044	15	12	2·7	1·73	31†

*29 c.f.s. in side channel.
†Different section.

Daily Gauge Height and Discharge of Kicking Horse River, at No. 2 Tunnel, for 1912.

Day.	July.		August.		September.		October.		November.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	4·15	306	4·3	333	3·05	150	2·1	60	1·8	40
2	4·25	324	4·4	351	3·0	144	2·1	60	1·75	37
3	4·3	333	4·3	333	2·95	138	2·1	60	1·7	34
4	4·05	288	4·45	360	3·0	144	2·1	60	1·8	40
5	4·1	297	4·2	315	2·8	122	2·1	60	1·8	40
6	4·25	324	4·5	370	2·8	122	2·1	60	1·8	40
7	4·3	333	4·15	306	2·75	117	2·0	53	1·8	40
8	4·25	324	4·1	297	2·7	112	2·0	53	1·8	40
9	4·25	324	4·2	315	2·7	112	2·0	53	1·8	40
10	4·3	333	4·2	315	2·7	112	2·0	53	1·8	40
11	4·4	351		298	2·7	112	2·0	53	1·7	34
12	4·25	324	4·05	288	2·9	133	2·0	53	1·7	34
13	4·35	342	3·95	272	2·85	128	2·0	53	1·7	34
14	4·45	360	3·9	264	2·75	117	2·0	53		
15	4·15	306	4·0	280	2·6	102	1·95	50		
16	4·2	315	4·25	324	2·6	102	1·9	46		
17	3·85	256	4·5	370	2·5	93	1·9	46		
18	3·85	272	4·4	351	2·5	93	1·9	46		
19	4·15	306	4·4	351	2·4	84	1·9	46		
20	4·15	306	4·5	370	2·4	84	1·9	46		
21	4·05	288	4·4	351	2·3	76	1·9	46		
22	4·05	288	4·5	370	2·3	76	1·9	46		
23	4·15	306	4·6	390	2·3	76	1·9	46		
24	4·15	306	6·2	784	2·2	68	1·9	46		
25	4·15	306		500	2·2	68	1·9	46		
26	4·2	315		350	2·2	68	1·9	46		
27	4·2	315		300	2·15	64	1·8	40		
28	4·0	280		250	2·1	60	1·8	40		
29	4·0	280		225	2·1	60	1·8	40		
30	4·05	288		200	2·1	60	1·8	40		
31	4·2	315		175			1·8	40		

MONTHLY DISCHARGE of Kicking Horse River, at No. 2 Tunnel, for 1912.

(Drainage area, 50 square miles.)

Month.	Discharge in Second Feet.				Run Off.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
July.....	360	256	310	6·2	7·1	19,100
August	784	175	334	6·7	7·7	20,500
September.	150	60	100	2·0	2·2	5,950
October...	60	40	50	1·0	1·2	3,070

NOTE.—The difference between the discharge at gauging stations at Field and No. 2 tunnel gives the discharge of the Yoho river. Accuracy, "A" and "B". Freeze-up occurred about November 15, 1912.

LANE CREEK (267).

Lane creek is a small irrigation stream, about 5 to 7 miles in length, rising in the hills near the Tranquille Forest Reserve, and flowing into North Thompson river from the west, about 14 miles north of Kamloops, near the north boundary of township 21-17-6. The creek is about 8 feet wide and 6 inches deep. On June 21, 1911, the discharge was 3·1 c.f.s., and gradually decreased during the summer, being practically dry during the latter part of July and all August. In 1912, the maximum discharge occurred on May 17, and was about 40 c.f.s. *See* miscellaneous measurements on Lane creek.

Nearly all the water in Lane creek is used for irrigation, there being several ditches just above the wagon road near the mouth. Two small individual ditches take part of the water, and the rest flows into the British Columbia Fruitlands canal.

NORTH LILLOOET RIVER (133).

North Lillooet river has its source in the Golden Ears mountain (5,560 feet) at an elevation of 4,000 feet. It joins South Lillooet river two miles from Pitt river, about 20 feet above sea-level. The drainage area is about 20 square miles, and precipitation varies from 70 inches at the mouth to 10 inches at the head-waters. The stream is open all the year round, and the winter conditions are not severe. About 5 miles above the mouth, the North Lillooet is within a few hundred feet of the South Lillooet. West of that point both streams flow through rich bottom lands, are deep and sluggish and at high water often overflow the surrounding lands. Some of these are being dyked and farmed, and are very valuable. The upper part of the watershed is mountainous. A prominent peak, mount Blanchard, known locally as the Golden Ears, rises to an elevation of 5,500 feet. This peak is snowcapped practically all the year round. In the upper part the stream falls very rapidly, and during high water many trees are washed out and carried down into the flats, where they give much trouble by obstructing the channel, causing the river to overflow and sometimes to even change its course.

The station was established by C. G. Cline on October 27, 1911, and gauge readings have been taken continuously ever since. It is located at the bridge on North Lillooet river at Sibley's blacksmith shop, just below a high-water slough from the

South Lillooet, and directly north of Port Haney. The gauge is a standard vertical staff gauge 7½ feet long, nailed to the south side of the planking on the piling of the bridge near the right bank. It is referred to three permanent bench-marks.

Low-water measurements are made by wading, and high-water measurements by cable suspension from the upstream side of the bridge. The banks are 5 feet high and covered with bushes. The bed of the stream is of sand and gravel. The river is apt to overflow in high water, especially if the water from the South river overflows into it, as it might do during a high flood. It would be very difficult to find a section where this would not occur when the South Lillooet is extremely high; and allowance can be made for it if it does happen. When the South Lillooet flood is properly controlled there will be no more danger of trouble from that source.

DISCHARGE MEASUREMENTS of North Lillooet river, five miles from mouth, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Oct. 27.	Cline and Smith	1,057	16	13	0·87	2·28	11·3[1]
Dec. 19.....	K. H. Smith....	1,057	47	163	1·8	4·35	291·0[2]
1912.							
Mar. 16..	C. G. Cline.	1,046	19	24·6	0·7	2·60	17·3[1]
July 4	"	1,046	32	24·7	0·9	2·70	22·8[3]
Aug. 17....	"	1,046	39	44·7	2·2	3·65	96·2[1]
Sept. 10	"	1,046	32	27·0	1·3	2·89	35·1[1]
Nov. 14...	"	1,046	42	115·0	1·5	3·91	170·0[2]

[1] Wading measurement
[2] Bridge measurement.
[3] Different section.

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DAILY GAUGE HEIGHT AND DISCHARGE of North Lillooet river, five miles from mouth, for 1911.

Day.	October.		November.		December.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			2·15	85	3·8	141
2			2·1	80	3·3	69
3			2·2	90	3·2	59
4			2·25	100	3·0	42
5			3·3	69	3·6	107
6			2·9	35	4·2	243
7			5·25	610	3·6	107
8			4·2	243	6·4	1,100
9			3·3	69	4·5	335
10			3·3	69	3·9	163
11			3·0	42	4·0	470
12			3·0	42	3·75	132
13			3·0	42	3·5	83
14			4·1	215	3·2	59
15			3·65	115	3·2	59
16			3·85	152	3·4	84
17			5·95	885	3·3	69
18			7·8	1,500	3·1	50
19			4·9	470	4·2	243
20			6·0	905	3·7	123
21			5·05	530	3·3	69
22			3·8	141	4·8	335
23			3·3	69	4·6	305
24			3·1	50	3·6	107
25			5·3	620	3·1	50
26			4·2	243	3·0	42
27			3·4	84	3·1	50
28	2·25	10	3·2	59	3·0	42
29	2·2	9	3·0	42	3·0	42
30	2·2	9	3·7	123	2·9	35
31		9			3·0	42

MONTHLY DISCHARGE of North Lillooet river, five miles above mouth, for 1911.

(Drainage area, 20 square miles.)

Month.	Discharge in Second Feet.				Run Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
November	1,500	50	250	12·5	13·9	14,900	
December	1,100	35	162	8·1	9·3	9,960	
The period							90

NOTE. Accuracy, "A" and "B."

DAILY GAUGE HEIGHT AND DISCHARGE of

Day	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1....	3·0	42	3·3	69	2·7	24	2·8	29	3·5	93	2·9	35
2....	3·0	42	3·2	59	2·7	24	2·8	29	3·2	59	2·9	35
3....	2·7	24	3·1	50	2·7	24	3·25	64	3·0	42	2·9	35
4....	2·7	24	3·1	50	2·6	20	3·2	59	3·0	42	2·8	29
5....	2·7	24	3·1	50	2·6	20	3·0	42	3·0	42	2·9	35
6....	2·7	24	3·2	59	2·6	20	2·8	29	3·0	42	3·0	42
7....	2·7	24	3·2	59	2·6	20	3·25	64	3·1	50	2·9	35
8....	2·7	24	4·5	335	2·55	18	3·3	69	3·5	93	2·9	35
9....	2·7	24	4·55	350	2·5	17	3·1	50	3·2	59	2·9	35
10....	2·8	29	4·1	215	2·5	17	2·9	35	2·9	35	2·8	29
11....	2·8	29	4·6	365	2·5	17	3·2	59	2·9	35	2·8	29
12....	2·7	24	3·9	163	2·5	17	3·2	59	3·1	50	4·6	365
13....	4·0	188	3·5	93	2·5	17	3·0	42	3·2	59	3·8	141
14....	4·9	470	4·7	400	2·5	17	2·9	35	3·5	93	3·6	107
15....	4·8	435	4·7	400	2·7	24	2·9	35	3·2	59	3·5	93
16....	4·5	335	5·3	630	2·7	24	2·8	29	2·9	35	3·2	59
17....	3·6	107	4·5	335	2·7	24	2·8	29	2·8	29	3·1	50
18....	3·3	69	4·2	243	2·7	24	3·1	50	2·8	29	3·0	42
19....	3·2	59	3·6	107	2·6	20	3·0	42	2·8	29	3·0	42
20....	3·2	59	3·3	69	2·6	20	2·9	35	3·4	81	3·0	42
21....	4·4	303	3·1	50	2·6	20	2·8	29	3·6	107	3·85	152
22....	3·9	163	3·1	50	2·6	20	2·8	29	3·5	93	3·2	59
23....	3·6	107	3·1	50	2·5	17	2·8	29	3·5	93	3·1	50
24....	4·2	243	3·0	42	2·5	17	2·9	35	3·3	69	2·9	35
25....	5·7	790	2·9	35	2·6	20	2·9	35	3·2	59	2·9	35
26....	3·4	81	2·9	35	2·7	24	2·9	35	3·4	81	2·9	35
27....	3·7	123	2·9	35	2·9	35	2·8	29	3·4	81	2·9	35
28....	4·7	400	2·9	35	2·9	35	3·6	107	3·4	81	2·8	29
29....	4·7	400	2·8	29	2·9	35	3·7	123	3·2	59	2·7	24
30....	5·1	559			2·8	29	3·8	141	3·0	42	2·7	24
31....	3·7	123			2·7	24			2·8	29		

North Lillooet river, five miles from mouth, for 1912.

July.		August.		September.		October.		November.		December.		
Gauge height	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Day.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
2·7	24	2·5	17	4·4	303	2·8	29	2·9	35	4·9	470	1
3·1	50	2·5	17	4·7	400	3·1	50	2·8	29	4·2	243	2
2·8	29	2·5	17	3·7	123	2·8	29	3·0	42	6·5	1,150	3
2·7	24	2·5	17	3·4	81	3·0	42	3·0	42	4·1	215	4
3·25	64	2·5	17	3·1	50	2·8	29	3·8	141	3·5	93	5
3·3	69	2·4	14	2·9	35	2·7	24	4·0	188	3·3	69	6
3·1	50	2·4	14	2·9	35	2·6	20	4·5	335	3·0	42	7
3·0	42	2·4	14	3·6	107	3·0	42	4·1	215	3·0	42	8
2·9	35	4·2	243	3·1	50	2·8	29	3·6	107	3·0	42	9
2·8	29	3·6	107	2·9	35	2·7	24	3·4	81	2·9	35	10
2·8	29	3·2	59	2·8	29	2·6	20	4·0	188	2·9	35	11
2·8	29	2·9	35	2·75	26	2·6	20	5·9	865	3·3	69	12
2·8	29	2·7	24	2·7	24	2·5	17	4·0	188	3·4	81	13
2·7	24	2·8	29	2·6	20	2·5	17	3·4	81	3·3	69	14
2·7	24	3·25	54	2·6	20	2·55	18	3·2	59	3·1	50	15
2·7	24	5·5	570	2·6	20	4·7	400	3·1	50	3·3	69	16
2·7	24	3·9	163	2·6	20	4·9	470	3·7	123	3·5	93	17
2·5	17	3·3	69	2·5	17	3·7	123	4·6	365	3·8	141	18
2·5	17	3·1	50	2·5	17	3·0	42	6·3	1,050	3·3	69	19
2·5	17	2·9	35	2·5	17	3·5	93	3·75	132	3·2	59	20
2·5	17	2·8	29	2·45	16	3·2	59	6·85	1,300	3·1	50	21
2·5	17	2·7	24	2·4	14	3·2	59	6·4	1,100	3·0	42	22
3·5	93	2·7	24	2·4	14	3·4	81	4·9	470	3·3	59	23
3·5	93	2·6	20	2·4	14	3·9	163	4·2	243	3·7	123	24
3·1	50	2·6	20	2·4	14	4·0	188	3·7	123	3·2	59	25
2·9	35	2·5	17	2·4	14	3·7	123	3·3	69	3·2	59	26
2·8	29	2·55	18	2·35	12	3·3	69	3·1	50	3·4	81	27
2·7	24	2·5	17	2·35	12	3·1	50	3·0	42	3·5	93	28
2·6	20	2·5	17	2·35	12	3·2	59	2·9	35	3·3	69	29
2·5	17	3·4	81	2·4	14	3·3	69	2·9	35	4·0	188	30
2·5	17	3·3	69			3·0	42			4·2	243	31

MONTHLY DISCHARGE of North Lillooet river, five miles from mouth, for 1912.

(Drainage area, 20 square miles.)

Month.	DISCHARGE IN SECOND FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
January	550	24	172	8·6	9·9	10,600	
February	630	29	154	7·7	8·3	8,860	
March	35	17	22	1·1	1·3	1,350	
April	141	29	49	2·5	2·8	2,930	
May	107	29	60	3·0	3·5	3,670	
June	365	24	60	3·0	3·3	3,560	
July	93	17	34	1·7	2·0	2,110	
August	570	14	62	3·1	3·6	3,790	
September	400	12	52	2·6	2·9	3,100	
October	470	17	81	4·0	4·6	4,950	
November	1,300	29	226	11·3	12·6	13,400	
December	1,150	35	136	6·8	7·8	8,360	
The year	1,300	12	92	4·6	62·6	66,680	90

NOTE. Accuracy, "A" and "C."

SOUTH LILLOOET RIVER (132).

South Lillooet river rises in Lillooet lakes at an elevation of 370 feet, discharging into Pitt river below Pitt lake at sea-level.

The precipitation in the Lillooet watershed varies from 70 inches per annum at the mouth to 100 inches, or more, at the head-waters. The stream is at present used for logging, but there are water-power possibilities on it.

The Burrard Power Company is at present planning a power development on this stream. A dam is to be constructed on Lillooet lake, and the freshet waters stored. A head of 800 feet is obtained by carrying the water in a flume along the north shore of the South Lillooet, 5¼ miles to a controlling reservoir and thence by 1,500 feet of pipe line to a power-house near the mouth of the South Lillooet. The original plan of development of this company was the diversion of water from the Lillooet lakes over the divide to Kanaka falls, near the Fraser river. The Burnett Lumber Company objected strenuously to the alienation of South Lillooet river water, since the company claimed the right to the use of the natural flow of the stream for logging purposes. From these objections sprang the famous Burrard Power Case through which the Dominion of Canada right of ownership to the water within the Railway Belt of British Columbia was formerly established.

There are extensive flats on both sides of the South Lillooet for 7 miles from the mouth, and part of this land is under cultivation at present. It is often flooded, and much of it must be dyked before it can be used for farming. The land is very fertile, and either open or easily cleared. The intermediate part of the watershed is composed of hills and plateaus, a few hundred feet high, with very valuable timber, mainly fir and cedar. Some of this has been cut, and logging operations are being carried on at present. The logs are run down the river during the freshets, but this method is not very satisfactory. The building of the proposed Vancouver-Mission tramline will

probably provide a better means of handling the timber. In the upper part of the watershed there are mountain peaks several thousand feet high, on some of which the snow remains nearly all summer, until washed down by the fall rain.

Near the mouth the stream is deep, sluggish, and is affected by the rise and fall of the tides. Higher up it is swift and comparatively shallow.

The station on the South Lillooet was established on October 26, 1911, by C. G. Cline, and continuous gauge readings have been taken ever since. It is located at the upper highway bridge across the South Lillooet, about 2½ miles from Port Haney and a quarter of a mile south of the Yennedon post office. This is about 7 miles above the mouth of the river and above tidal influence. It is 5 miles above the mouth of the North Lillooet and 7 miles below Lillooet lake.

The gauge is a chain gauge, located near the middle of the bridge on the down stream side, plumber's chain with a plumb-bob, 24·3 feet long over all. There is also a vertical staff gauge 8 feet long attached to the crib work of the bridge. Both gauges are referred to the same datum, and three bench-marks are established. Measurements are made from the bridge, and the stream is confined by the bridge piers and the road way to one channel. The bed of the stream is of sand and gravel, and there is a slight danger of backwater, through logs lodging in the stream.

Discharge Measurements of South Lillooet river, near Haney, 1911-12.

Date.	Hydrographer.	Meter No	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Oct. 26	Cline & Smith	1057	100	113	2·0	1·18	226
Dec. 13	K. H. Smith	1057	100	316	4·3	2·80	1,360
1912.							
July 4	C. G. Cline	1046	115	151	2·4	1·70	361
Aug. 17	"	1046	125	288	3·5	2·70	1,010
Sept. 10	"	1046	115	234	3·3	2·00	767
Nov. 13	"	1046	125	608	8·1	4·60	1,950

DAILY GAUGE HEIGHT AND DISCHARGE of South Lillooet river, near Haney, B.C., for 1911.

DAY.	OCTOBER.		NOVEMBER.		DECEMBER.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·9	150	2·3	810
2			0·9	150	2·4	890
3			1·0	170	2·1	660
4			0·9	150	2·1	660
5			0·9	150	2·2	730
6			1·2	230	2·3	810
7			1·9	530	2·4	890
8			2·7	1,160	3·7	2,460
9			2·5	970	4·2	3,360
10			2·2	730	3·4	2,000
11			2·0	590	3·4	2,000
12			2·0	590	3·0	1,480
13			1·9	530	2·8	1,260
14			2·1	660	2·7	1,160
15			2·0	590	2·6	1,060
16			2·5	970	2·5	970
17			3·8	2,630	2·4	890
18			5·2	5,670	2·2	730
19			5·0	5,170	3·0	1,480
20			5·2	5,670	3·0	1,480
21			5·0	5,170	2·8	1,260
22			4·2	3,360	2·8	1,260
23			3·4	2,000	4·0	2,990
24			3·0	1,480	3·4	2,000
25			3·6	2,300	3·1	1,600
26			3·2	1,730	2·8	1,260
27	1·2	230	3·0	1,480	2·3	810
28	1·1	200	2·6	1,060	2·1	660
29	1·1	200	2·4	890	2·0	590
30	1·0	170	2·2	730	1·9	550
31	1·0	170			1·8	470

MONTHLY DISCHARGE of South Lillooet river, near Haney, B.C., for 1911.

MONTH.	DISCHARGE IN SECOND-FEET.			RUN-OFF.	RAIN-FALL.
	Maximum.	Minimum.	Mean.	Total in acre-feet.	Inches.
November	5,670	150	1,589	94,600	
December	3,360	470	1,235	77,800	
The period					70 to 80

NOTE.—This station was established on October 26, 1911. The flow during November and December is greater on the South Lillooet river than for any corresponding time of the year.

Accuracy, "B" and "C."

Daily Gauge Height and Discharge of

Day.	January.		February.		March.		April.		May.		June.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1....	1·5	330	3·3	1,860	1·6	380	1·3	260	2·5	970	2·3	810
2....	1·2	230	2·8	1,260	1·5	330	1·4	290	2·3	810	2·1	660
3....	1·0	170	2·6	1,060	1·5	330	1·6	380	2·3	810	2·0	590
4....	1·2	230	2·4	1,890	1·4	290	1·7	430	2·2	730	1·9	530
5....	1·1	200	2·4	890	1·3	260	1·8	470	2·2	730	1·9	530
6....	1·0	170	2·1	660	1·3	260	1·8	470	2·2	730	1·9	530
7....	1·0	170	2·0	590	1·2	230	1·9	530	2·1	660	2·0	590
8....	1·0	170	2·6	1,060	1·1	200	2·0	590	2·1	660	2·0	590
9....	1·1	200	3·2	1,730	1·0	170	2·1	660	2·2	730	1·9	530
10....	0·9	150	3·5	2,150	1·0	170	2·0	590	2·5	970	1·9	530
11....	1·0	170	3·5	2,150	0·9	150	1·9	530	2·4	890	2·0	590
12....	1·4	290	3·6	2,300	0·8	130	1·8	470	2·3	810	2·8	1,260
13....	1·5	330	3·4	2,000	0·9	150	1·7	430	2·2	730	3·0	1,480
14....	3·4	2,000	3·8	2,630	1·0	170	1·6	380	2·3	810	3·2	1,730
15....	3·6	2,300	3·7	2,460	1·0	170	1·8	470	2·5	970	3·2	1,730
16....	3·8	2,630	3·9	2,810	1·05	185	1·7	430	2·4	890	3·0	1,480
17....	3·3	1,860	3·8	2,630	1·1	200	1·7	430	2·3	810	2·8	1,260
18....	3·4	2,000	3·6	2,300	1·1	200	1·6	380	2·2	730	2·6	1,060
19....	3·2	1,730	3·3	1,860	1·1	200	1·7	430	2·1	660	2·5	970
20....	3·0	1,480	2·9	1,370	1·05	185	1·6	380	2·0	590	2·4	890
21....	3·1	1,600	2·4	890	1·0	170	1·6	380	2·2	730	2·4	890
22....	3·4	2,000	2·4	890	1·0	170	1·5	330	2·4	890	2·3	810
23....	3·3	1,860	2·3	810	1·09	150	1·6	380	2·3	810	2·2	730
24....	3·5	2,150	2·2	730	1·09	150	1·5	330	2·2	730	2·1	660
25....	4·3	3,560	2·1	660	1·09	150	1·5	330	2·1	660	2·0	590
26....	4·2	3,360	1·8	470	1·0	170	1·5	330	2·2	730	2·0	590
27....	3·4	2,000	1·7	430	1·1	200	1·5	330	2·3	810	1·9	530
28....	3·5	2,150	1·7	430	1·2	230	1·8	470	2·5	970	1·8	470
29....	3·6	2,300	1·7	430	1·2	230	2·3	810	2·6	1,060	1·8	470
30....	4·2	3,360	.....	.....	1·3	260	2·5	970	2·5	970	1·7	430
31....	3·8	2,630	.....	.....	1·3	260	.....	.....	2·3	810	.....	.....

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South Lillooet river, near Haney, B.C., for 1912.

July.		August.		September.		October.		November.		December.		Day.
Gauge height	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
1·7	430	1·4	290	2·0	590	1·1	200	2·0	590	2·2	730	1
1·7	430	1·3	260	3·3	1,860	1·2	230	2·0	590	2·5	970	2
1·7	430	1·3	260	3·3	1,860	1·4	290	1·9	530	3·5	2,150	3
1·7	430	1·2	230	3·2	1,730	1·3	260	2·0	590	3·2	1,730	4
1·8	470	1·1	200	2·8	1,260	1·3	260	2·5	970	2·9	1,370	5
2·0	590	1·1	200	2·2	730	1·3	260	3·2	1,730	2·6	1,060	6
2·1	660	1·1	200	2·2	730	1·3	230	3·6	2,300	2·4	890	7
2·1	660	1·0	170	2·1	660	1·4	290	3·4	2,000	2·2	730	8
1·9	530	1·6	380	2·1	660	1·4	290	3·0	1,480	2·0	590	9
1·8	470	2·0	590	2·0	590	1·3	260	3·0	1,480	2·0	590	10
1·7	430	2·2	730	1·9	530	1·2	230	2·8	1,260	1·8	470	11
1·6	380	2·2	730	1·8	470	1·2	230	3·0	1,480	2·3	810	12
1·6	380	2·1	660	1·7	450	1·1	200	3·2	1,730	2·6	1,060	13
1·6	380	2·0	590	1·6	380	1·1	200	4·6	4,220	2·9	1,370	14
1·5	330	2·0	590	1·6	380	1·2	230	3·8	2,630	3·0	1,480	15
1·5	330	2·8	1,260	1·5	330	1·8	470	3·3	1,860	2·7	1,160	16
1·4	290	2·8	1,260	1·5	330	3·0	1,480	2·7	1,160	2·6	1,060	17
1·3	260	2·7	1,160	1·4	280	2·8	1,260	3·2	1,730	2·6	1,060	18
1·3	260	2·6	1,060	1·3	260	3·0	1,480	5·0	5,170	2·7	1,160	19
1·3	260	2·2	730	1·2	230	2·9	1,370	5·1	5,420	2·7	1,160	20
1·3	260	2·1	660	1·1	200	2·6	1,060	5·4	6,190	2·6	1,060	21
1·2	230	1·9	530	1·1	200	2·7	1,160	4·8	4,680	2·5	970	22
1·3	260	1·8	470	1·0	170	2·8	1,260	4·4	3,780	2·4	890	23
1·4	290	1·7	430	1·0	170	2·9	1,370	3·8	2,630	2·5	970	24
1·7	430	1·6	380	1·0	170	3·1	1,600	3·6	2,300	2·5	970	25
1·7	430	1·6	380	1·0	170	3·3	1,860	3·0	1,480	2·4	890	26
1·6	380	1·5	330	0·9	150	3·3	1,860	2·7	1,160	2·4	890	27
1·6	380	1·4	290	0·9	150	2·8	1,260	2·4	890	2·5	970	28
1·5	330	1·4	290	0·9	150	2·5	970	2·2	730	2·6	1,060	29
1·5	330	1·5	330	1·0	170	2·3	810	2·0	590	2·7	1,160	30
1·4	290	1·8	470			2·2	730			3·0	1,480	31

Monthly Discharge of Lillooet river, near Haney, B.C., for 1912.

Month.	Discharge in Second-Feet.			Run-off.	Rainfall.
	Maximum.	Minimum.	Mean.	Total in acre-feet.	Inches.
January	3,560	150	1,412	86,800	
February	2,810	430	1,393	80,000	
March	380	130	210	12,900	
April	970	260	455	27,000	
May	1,060	590	802	49,300	
June	1,730	430	817	48,600	
July	660	260	387	23,800	
August	1,260	170	520	32,000	
September	1,860	150	533	31,700	
October	1,860	200	763	46,900	
November	6,190	530	2,111	125,600	
December	2,150	470	1,062	65,200	
The year	6,190	130	872	630,000	70 to 109

Note.—Accuracy, "B" and "C."

Louis Creek (243).

Louis creek has its source in the Niskonlith creek divide, (township 21, R. 14, west 6th meridian) at an elevation of 3,100 feet, and discharges into the North Thompson from the east, 36 miles north of Kamloops, at an elevation of 1,160 feet. It is part of the Thompson drainage; the drainage area, as measured from the Geological survey map, dated 1895, scale 2 miles to an inch, is 180 square miles. Of this area, 160 square miles is above the river station. Louis creek has a small industrial water-power, and is used a little for irrigation purposes near the mouth in the North Thompson valley. The ranches in the Louis creek valley do not require irrigation except in very dry years, as the stream is almost entirely outside the Dry Belt. It is probable that the mean annual precipitation is from 15 to 25 inches. The valley is bounded by high precipitous mountains, heavily timbered, whose snow feeds the creek as well as its tributaries, Fadear, Cahilty, and McGillivary creeks, entering from the east, and Christian creek from the west, near the head-waters. There is a small sawmill at the mouth operated by power from the creek, and similar industrial powers would be possible on the lower 5 miles of the stream, where the stream falls rapidly, in contrast to its sluggishiness in its upper twenty miles. The tributaries of Louis creek also have good power possibilities and, should a market arise, would warrant a thorough investigation.

The river station on Louis creek was established on August 16, 1911, by C. G. Cline. It is located at a bridge on the Leslie ranch, 2 miles south of the Railway Belt boundary, and about 12 miles from the mouth. The purpose of this location was to determine the amount of Louis creek water rising in the Railway Belt. A standard vertical staff gauge, 7 feet long, is located on the right bank 50 feet above the aforementioned bridge, and its datum referred to three bench-marks. The measuring section is at the bridge; in low water, the measurements are made by wading, in high water by means of a cable from the bridge. This is a good section, the control is fair, the current uniform, the banks high, and one permanent channel.

Discharge Measurements of Louis Creek, below Cahilty creek, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Aug. 16	C. G. Cline	1046	25	33·4	0·8	0·91	28
Sept. 18	"	1046	26	36·8	0·96	0·98	35·4
1912.							
Apr. 30	Cline & Dann	1046	26	49·4	1·7	1·50	94
May 16	E. M. Dann	1044	30·8	108	4·0	3·80	439
May 29	"	1044	28	90	3·6	3·20	328
June 8	"	1044	28	82·4	3·4	2·72	276
June 9	"	1044	28	85·1	3·4	2·81	288
Aug. 22	H. J. E. Keyes	1057	30	18·7	2·8	1·02	52*

*Different metering section.

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DAILY GAUGE HEIGHT AND DISCHARGE of Louis creek, below Cahilty creek, for 1911.

Day.	August.		September.		October.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·75	17	0·85	24
2			0·7	14	0·85	24
3			0·7	14	0·8	20
4			0·85	24	0·8	20
5			0·95	32	0·8	20
6			0·92	29	0·8	20
7			0·9	27	0·8	20
8			0·9	27	0·8	20
9			0·95	32	0·8	20
10			0·95	32	0·75	17
11			0·8	20	0·75	17
12			0·8	20	0·75	17
13			0·85	24	0·75	17
14			1·12	48	0·75	17
15			1·1	46	0·75	17
16	0·9	27	1·07	43	0·75	17
17	0·9	27	1·02	38	0·75	17
18	0·9	27	1·0	36	0·75	17
19	0·85	24	0·95	32	0·75	17
20	0·85	24	0·95	32	0·75	17
21	0·85	24	0·95	32	0·75	17
22	0·85	24	0·9	27	0·75	17
23	0·85	24	0·9	27	0·7	14
24	0·85	24	0·9	27	0·7	14
25	0·85	24	0·9	27	0·7	14
26	0·8	20	0·9	27	0·7	14
27	0·8	20	0·85	24	0·7	14
28	0·75	17	0·85	24	0·75	17
29	0·75	17	0·85	24	0·75	17
30	0·75	17	0·85	24	0·75	17
31	0·75	17			0·75	17

MONTHLY DISCHARGE of Louis creek below Cahilty creek, for 1911.
(Drainage area, 100 square miles.)

Month.	Discharge in Second-Feet.				Run Off.		Rainfall.
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on drainage area.	Total in acre-feet.	Inches.
September	48	14	28·3	0·28	0·31	1,680	
October	24	14	17·6	0·18	0·21	1,080	
The period							15

NOTE.—Station established August 16; readings in November and December affected by ice conditions.
Accuracy, "B."

DAILY GAUGE HEIGHT AND DISCHARGE of

DAY.	APRIL.		MAY.		JUNE.		JULY.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	0·65	34	15	94	2·75	270	1·55	100
2	0·7	36	1·5	94	2·62	249	1·65	111
3	0·75	38	1·6	105	2·47	225	1·62	107
4	0·75	38	1·6	105	2·42	218	1·62	107
5	0·7	36	1·7	117	2·37	210	1·82	133
6	0·7	36	1·17	126	2·37	210	1·77	126
7	0·7	36	1·87	140	2·47	225	1·77	126
8	0·8	40	2·27	196	2·72	265	1·67	113
9	0·8	40	2·57	241	2·75	270	1·57	102
10	0·85	43	2·45	222	2·6	246	1·5	94
11	0·95	48	2·45	222	2·57	241	1·52	96
12	0·97	49	2·57	241	2·77	273	1·4	84
13	0·92	46	2·77	273	2·85	286	1·45	89
14	0·9	45	3·02	313	2·6	246	1·37	81
15	0·9	45	3·55	398	2·97	305	1·3	74
16	0·9	45	3·85	446	3·0	310	1·27	71
17	0·9	45	3·72	425	2·65	254	1·25	70
18	0·9	45	3·37	369	2·55	238	1·2	65
19	0·9	45	3·2	342	2·45	222	1·2	65
20	0·9	45	3·37	369	2·32	203	1·15	61
21	0·9	45	3·9	454	2·2	186	1·1	57
22	0·95	48	4·1	485	2·05	165	1·15	95
23	1·0	50	4·27	514	1·87	140	1·65	111
24	1·05	54	4·3	520	1·77	126	1·6	105
25	1·1	57	4·2	500	1·67	113	1·52	96
26	1·1	57	4·12	488	1·6	105	1·42	86
27	1·1	57	4·12	488	1·6	105	1·32	76
28	1·1	57	3·67	417	1·57	102	1·3	74
29	1·15	61	3·27	353	1·5	94	1·22	67
30	1·25	70	3·05	318	1·5	94	1·2	65
31	1·5	94	2·85	286			1·15	61

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Louis creek, below Cahilty creek, for 1912.

August		September.		October.		November.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
1·15	61	1·15	61	0·9	45	0·85	43	1
1·15	61	1·17	63	0·9	45	0·85	43	2
1·1	57	1·32	76	0·9	45	0·85	43	3
1·1	57	1·27	71	0·9	45	0·85	43	4
1·1	57	1·2	65	0·9	45	0·85	43	5
1·05	54	1·2	65	0·9	45	0·85	43	6
1·0	50	1·32	76	0·9	45	0·85	43	7
1·0	50	1·37	81	0·9	45	0·85	43	8
1·17	63	1·3	74	0·9	45	0·85	43	9
1·1	57	1·25	70	0·9	45	0·85	43	10
1·22	67	1·2	65	0·9	45	0·85	43	11
1·15	61	1·17	63	0·9	45	0·85	43	12
1·1	57	1·15	61	0·9	45	0·90	45	13
1·05	54	1·1	57	0·9	45	0·85	43	14
1·1	57	1·07	55	0·9	45	0·85	43	15
1·3	74	1·05	53	0·9	45	0·85	43	16
1·4	84	1·0	50	1·07	55			17
1·3	74	1·0	50	1·05	53			18
1·22	67	1·0	50	1·02	51			19
1·1	57	1·0	50	1·0	50			20
1·1	57	0·95	48	0·95	48			21
1·05	54	0·95	48	0·95	48			22
1·0	50	0·95	48	0·95	48			23
1·0	50	0·95	48	0·95	48			24
1·0	50	0·95	48	0·95	48			25
1·0	50	0·95	48	0·95	48			26
0·95	48	0·95	48	0·95	48			27
1·0	50	0·9	45	0·9	45			28
1·0	50	0·9	45	0·85	48			29
1·0	50	0·9	45	0·85	48			30
1·05	54			0·85	48			31

MONTHLY DISCHARGE of Louis creek, below Cahilty creek, for 1912.

(Drainage area, 100 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	94	34	47·6	0·48	0·53	2,830	
May	520	94	312	3·1	3·6	19,200	
June	310	94	207	2·07	2·31	12,300	
July	133	57	89·3	0·89	1·0	5,490	
August	84	50	57·5	0·57	0·66	3,540	
September	81	45	57·6	0·58	0·65	3,430	
October	55	43	46·4	0·46	0·53	2,850	
The period							15

NOTE.—Readings taken during January, February and March affected by ice-conditions. Accuracy, "B."

MARTIN CREEK (256).

Martin creek is a small irrigation stream rising in the hills on the south side of the Thompson valley, 3 miles southeast of Pritchard. The stream flows in a northwesterly direction, discharging into South Thompson river at an elevation of 1,150 feet, in township 19-14-6.

Martin creek is about 5 miles long, from 5 feet to 10 feet wide, and from 6 inches to 1 foot deep. The drainage area is about 5 square miles. The precipitation varies from 9 inches to 14 inches, of which about 5 inches is snowfall. The summers are hot and dry and the winters are not very severe, (−20° F).

The stream is not contentious. Practically all the water is used by the old Martin Estate.

A gauging station was established on this stream on May 31, 1911, by C. E. Richardson. The gauge is a standard staff, and is located about 40 feet above the Ross (Martin Estate) diversion. Readings were taken during 1911; the station was then abandoned, as the stream is not very important.

DISCHARGE MEASUREMENTS of Martin creek, above Ross' Diversion, 1911.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 31	C. E. Richardson	1048	3·8	2·7	1·9	0·8	5·1
Sept. 3	"	Float	1·4	0·28	2·5	0·32	0·07

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DAILY GAUGE HEIGHT AND DISCHARGE of Martin creek, above Ross' Diversion, for 1911.

Day.	JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.	
	Gauge Height	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge Height	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec. ft.
1	0·8	5·1	0·4	0·5				0	0·4	0·5	0·3	0
2	0·8	5·1	0·4	0·5	0·3	0		0	0·4	0·5	0·3	0
3	0·8	5·1	0·4	0·5	0·3	0		0	0·4	0·5	0·3	0
4	0·75	4·4	0·4	0·5	0·3	0		0	0·4	0·5	0·32	0·1
5	0·65	3·3	0·4	0·5	0·3	0		0	0·4	0·5	0·35	0·2
6	0·65	3·3	0·4	0·5	0·35	0·2		0	0·4	0·5	0·35	0·2
7	0·6	2·5	0·4	0·5	0·35	0·2	0·3	0	0·4	0·5	0·4	0·5
8	0·6	2·5	0·45	1·0	0·3	0	0·3	0	0·4	0·5	0·4	0·5
9	0·6	2·5	0·45	1·0		0	0·35	0·2	0·4	0·5	Frozen	0·5
10	0·6	2·5	0·45	1·0		0	0·35	0·2	0·4	0·5		0·5
11	0·6	2·5	0·45	1·0			0·35	0·2	0·4	0·5		0·2
12	0·55	2·0	0·45	1·0			0·35	0·2	0·4	0·5		0·2
13	0·55	2·0	0·45	1·0			0·4	0·5	0·4	0·5	0·35	0·2
14	0·55	2·0	0·45	1·0			0·4	0·5	0·4	0·5	0·4	0·5
15	0·5	1·4	0·45	1·0			0·4	0·5	0·35	0·2	0·4	0·5
16	0·5	1·4	0·45	1·0			0·4	0·5	0·35	0·2	0·4	0·5
17	0·5	1·4	0·45	1·0			0·4	0·5	0·35	0·2	0·4	0·5
18	0·5	1·4	0·45	1·0			0·4	0·5	0·35	0·2		
19	0·5	1·4	0·45	1·0	No flow		0·4	0·5	0·35	0·2		
20	0·45	1·0	0·45	1·0			0·4	0·5	0·32	0·1		
21	0·45	1·0	0·4	0·5			0·4	0·5	0·32	0·1		
22	0·45	1·0	0·4	0·5			0·4	0·5	0·3			
23	0·45	1·0	0·4	0·5			0·4	0·5	0·3			
24	0·45	1·0	0·4	0·5			0·4	0·5	0·3			
25	0·45	1·0	0·4	0·5			0·4	0·5	0·3			
26	0·45	1·0	0·35	0·2			0·4	0·5	0·3			
27	0·45	1·0	0·35	0·2			0·4	0·5	0·3			
28	0·4	0·5	0·35	0·2			0·4	0·5	0·3			
29	0·4	0·5	0·35	0·2			0·4	0·5	0·3			
30	0·4	0·5	0·30				0·4	0·5	0·3			
31			0·30						0·3			

MONTHLY DISCHARGE of Martin creek, above Ross' Diversion, for 1911.

Month	DISCHARGE IN SECOND-FEET.				RUN OFF.	
	Maximum	Minimum	Mean.	Per sq. mile	Depth in inches on Drainage area.	Total in acre-feet.
June	5·1	0·5	2·04	0·41	0·46	121
July	1·0	0	0·64	0·13	0·15	39
August	0·2	0	0·01	0·002	0·002	0·6
September	0·5	0	0·33	0·065	0·07	20
October	0·5	0	0·27	0·05	0·06	17
November	0·5	0	0·30	0·06	0·07	18

NOTE.—Accuracy, "D."

Meadow Creek (257).

Meadow creek has its source in the hills between Kamloops lake and Nicola river, at an elevation of 4,100 feet, and discharges into Guichon creek about 5 miles above Mamit lake, at an elevation of 3,300 feet. It is part of the Guichon-Nicola-Thompson drainage; the drainage area, as measured from a Geological Survey map, dated 1895, scale 2 miles to an inch, is 145 square miles. There are several small unnamed streams discharging into Meadow creek, but the only important tributary is Greenstone creek. Meadow creek is an irrigation stream in the Dry Belt; the summers are hot and dry, the winters long and severe about (–30° F.); the annual precipitation is about 15 inches. Meadow creek is a sluggish stream, about 16 miles long, flowing from Trout lake through flat meadows, which vary from one-quarter to one mile in width; these meadows are often flooded during the summers by beaver dams, causing great annoyance to the ranchers. The last four miles is of greater slope, making the stream very tumultuous near the mouth, especially in high water. On this account it is very difficult to find a suitable location for a gauge in the vicinity.

Meadow creek is the principal tributary of Guichon creek, and hence becomes a very contentious stream. Water could be stored in Trout lake, but its drainage area is so small that it is questionable whether there would be enough water to warrant the expenditure. The same objection applies to Ridge lake (a small lake lying to the southwest of Trout lake). Water could be stored in Face and Big Fish lakes at the head of Greenstone creek, but as the average daily discharge of Greenstone is less than 10 second-feet for the irrigation season, and records are held by the owners of the Watson meadows for more water than actually exists in Greenstone creek, the damming of these lakes would be of interest only to the holders of records on Greenstone creek. (For further information see Greenstone creek.)

The river station on Meadow creek was established June 5, 1911, by W. M. Carlyle. The measuring section is located about 300 yards above the Mamit lake wagon road, just below the gauge. A standard vertical staff gauge is located on the right bank about 400 yards from the mouth. The measuring section is excellent in low water, the control is good, the current uniform, and the bed permanent. In high water, however, the stream is so rapid and tumultuous that measurements are taken at the road, where the stream runs in three channels. The datum of the gauge is referred to three bench-marks.

DISCHARGE MEASUREMENTS of Meadow creek, near mouth, 1911-12.

Date	Hydrographer	Meter No.	Width.	Area of section.	Mean velocity	Gauge height.	Discharge.
1911.			Feet.	Sq. ft.	Feet per sec.	Feet.	Sec.-ft.
June 5	W. M. Carlyle	1044	58	29·8	2·1	1·78	41·5
June 27	"	1044	11	6·0	0·3	0·89	1·74
July 19	"	1044	0·7	0·56	1·8	0·58	0·64
Aug. 7	"	1044	1·8	0·57	0·25	0·52	0·25
Aug. 9	"	1044	13	9·92	0·64	1·00	6·01
Aug. 9	"	1044	13	13·0	1·1	1·30	13·9
1912.							
April 28	H. J. Keys	1057	21	22·6	1·21	1·50	27·5
May 14	"	1057	96·5	49·2	4·2	3·10	207·5
May 21	"	1057	39·0	56·1	3·7	2·40	141·4
May 31	"	1057	18·0	18·0	4·15	2·00	78·1
June 10	"	1057	17·0	9·5	2·24	1·39	21·3
June 24	"	1057	8·0	6·2	1·68	1·13	10·4
July 2	"	1057	8·5	6·2	1·35	1·10	8·4
July 15	"	1057	11·7	8·3	1·07	1·23	8·96
July 30	"	1057	6·2	4·2	0·87	0·96	3·65
Aug. 16	"	1057	5·8	3·72	0·96	0·92	3·57
Sept. 3	"	1057	6·5	5·4	1·35	1·10	7·3
Sept. 16	"	1057	5·5	3·9	1·0	0·90	3·97

[1] New Measuring section.

GAUGE HEIGHTS AND DAILY DISCHARGE of Meadow creek, near mouth, for 1911.

Day.	June.		July.		August.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1				1·31	0·30	0·06
2			0·72	1·31		0·05
3				1·31		0·04
4			0·72	1·31		0·03
5	1·78	41·6		1·31	0·20	0·02
6		38·5		1·31		0·14
7	1·70	35·0	0·72	1·31	0·52	0·26
8		31·5		1·31	1·05	6·85
9		28·0	0·72	1·31	1·15	9·50
10	1·52	23·5		1·60		6·50
11		20·0		2·00	0·80	2·12
12		16·5	0·80	2·12		1·80
13	1·25	12·4		1·90		1·50
14		11·5		1·40	0·70	1·11
15	1·18	10·3	0·68	0·99		0·80
16		8·5		0·98		0·60
17	1·02	6·12		0·99	0·50	0·20
18		5·2		0·99		0·18
19		4·2	0·68	0·99		0·16
20	0·88	3·30		0·50		0·14
21		2·8	0·52	0·26	0·40	0·12
22	0·82	2·42		0·50		0·10
23		2·5		0·60		0·08
24		2·6	0·65	0·81		0·05
25		2·71		0·60		0·05
26	0·85	2·85		0·40	0·25	0·04
27	0·80	2·12	0·50	0·20		
28		1·90		0·18		
29	0·75	1·62		0·12	Creek dr	
30		1·40	0·40	0·12		
31				0·08		

MONTHLY DISCHARGE of Meadow creek, near mouth, for 1911.

(Drainage area, 145 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June..	41·6	1·4	14·0	0·1	0·1	833	
July....	2·12	0·28	0·97	0·01	0·01	60	
August	9·5	0·62	1·25	0·01	0·01	77	
The period.							12

NOTE.—Station maintained only during the irrigation season.
Accuracy "B."

GAUGE HEIGHTS AND DAILY DISCHARGE of Meadow creek near mouth, for 1912.

Day.	April.		May.		June.		July.		August.		September.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1.		3·0		49·5		70·0		6·3		3·2	1·0	4·4
2.	1·0	4·4	1·8	55·0	1·85	60·5		8·2	0·9	2·8		5·2
3.	.....	7·3		60·5		55·0	1·2	10·1		2·5		6·0
4.	1·2	10·1	1·9	66		49·5		9·3	0·85	2·3	1·1	6·8
5.		7·9		78	1·7	44	1·15	8·4		2·3		5·6
6.	1·05	5·6	2·1	91		39·5		11·6		2·3	1·0	4·4
7.		11·6		118	1·6	35	1·3	14·8	0·85	2·3		4·6
8.		17·6	2·5	146		26·2		13·2		2·1	1·12	4·9
9.	1·45	23·5		183	1·35	17·4		11·6	0·8	2·0		5·5
10.		23·5	3·0	220		16·8	1·2	10·1		2·0		6·1
11.		23·5	..	210		16·2		10·1	0·8	2·0	1·1	6·8
12.	1·45	23·5		200		15·5	1·2	10·1		2·3		5·6
13.		24·7	2·8	190	1·3	14·8		10·1		2·6	1·0	4·4
14.		25·9	3·1	235		14·8	1·2	10·1	0·9	2·8		4·4
15.	1·5	27·0	3·0	220	1·3	14·8		9·3		2·8	1·0	4·4
16.		23·0		220		16·1		8·5	0·9	2·8		
17.		18·9	3·0	220	1·35	17·4		7·7		4·2		
18.	1·3	14·8		280		16·6	1·1	6·8	1·05	5·6		
19.		14·8	2·7	175	1·32	15·8		5·6		6·8		
20.	1·3	14·8		165		15·3	1·0	4·4		8·0		
21.		12·3		155	1·3	14·8	1·2	10·1	1·17	9·1		
22.	1·2	10·1	2·5	146		13·6		9·5		20·0		
23.		15·0		142	1·25	12·4		8·9	1·55	31·0		
24.	1·4	20·0	2·45	139		10·1	1·15	8·4		19·7		
25.		22·3	.....	135		7·8		7·6	1·15	8·4		
26.		24·6	2·4	132	1·05	5·6	1·1	6·8		7·1		
27.	1·5	27·0		123		4·6		6·2		5·8		
28.		32·7		114	0·95	3·6	1·05	5·6	1·0	4·4		
29.		38·4	2·2	104		4·0		4·9		3·3		
30.	1·7	44·0		91	1·0	4·4		4·2	0·85	2·3		
31.			2·0	78			0·95	3·6		3·3		

MONTHLY DISCHARGE of Meadow Creek, near mouth, for 1912.

(Drainage area, 145 square miles.)

Month.	Discharge in Second-Feet.				Run Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on drainage area.	Total in acre-feet.	Inches.
April...	44·0	3·0	19·1	0·13	0·145	1,136	
May.....	235·0	49·5	144·0	1·0	1·15	8,850	
June....	70·0	3·6	21·7	0·15	0·17	1,290	
July....	14·8	3·6	8·4	0·06	0·07	516	
August.	31·0	2·0	5·7	0·04	0·05	350	
The period.							15

Note—Station maintained only during the irrigation season. Accuracy, "A".

MESLILOET RIVER (103).

Mesliloet river (or Indian river) has its source in the mountains north of the Railway Belt boundary, at an elevation of between two and three thousand feet, and discharges into the north arm of Burrard inlet at sea-level. The drainage area, as measured from a provincial map, scale 10 miles to 3·05 inches, is 75 square miles. The hills in which the Mesliloet rises are quite close to the coast, and receive a heavy precipitation. In the winter a heavy snowfall is apt to be followed by a thaw or a rain, which causes great fluctuations in the flow of the stream, especially as there is no lake on the main stream to act as a regulator. The hills are in the main, steep and rocky; this also tends to give a rapid run-off.

There is a considerable amount of good timber in this watershed, principally fir and cedar; cedar shingle bolts are being cut at present, and floated down stream to tidewater; this stream, however, is not suitable for running logs and a logging railroad will have to be built to get out the fir. A company proposes to build a saw-mill on the North Arm at the mouth of the Mesliloet, and have driven piles for the booming grounds; this company is also investigating the power possibilities of the stream and its tributaries, Hixon and Brandt creeks. The Mesliloet proper has a fall of 350 feet in 2½ miles; while Brandt and Hixon have falls of 1,800 and 2,000 feet in 2 and 2½ miles respectively. There are good gravel deposits at the mouth of the river, and two dredges are at present dredging gravel for use in the city of Vancouver. The Indian River Park Company has built a summer hotel (Wigwam Inn) and park near the mouth of the river, and their steamer makes two trips a day to Vancouver during the season. There is little agricultural land in the watershed, and none is worked; the only inhabitants, except those at the mouth, being a few lumbermen in a camp 5 miles up stream. About 8 miles up there is a canyon, with rapids; for the most part the stream is rapid, with frequent riffles. Salmon run up the Mesliloet for several miles, and a good catch is made every year by the Indians.

The river station on the Mesliloet river was established March 14, 1912, by C. G. Cline. The measuring section is located 1 mile up stream above the influence of the tide, which comes up a little more than one-half a mile. A chain gauge of No. 14 Jack chain, suspending a 14-pound sash weight, is located on the left bank, 100 feet above the measuring section. The datum of the gauge is referred to three bench-

marks. The measurements are made from a canoe, attached to a cable suspended across the stream, either by a meter rod or by a meter on a cable; in low water, wading measurements are made one-quarter of a mile above the gauge. This is an excellent measuring section; there is good control, high banks, swift, uniform current, and one channel with a permanent bed; there is, however, a possible chance of backwater for an hour or so during high tide.

There are six other stations in this watershed; these have only recently been established and no discharge data have yet been compiled: Mesliloet river (upper station) (104), Hixon creek (105), Belknap creek (106), Brandt creek (107), Norton creek (108), Young creek (109).

The Westminster Power Company, having made application for water-power privileges on the Mesliloet, and its tributaries, Brandt, Young, Norton, Hixon, and Belknap creeks, with storage rights on Young, Norton, and Belknap lakes, C. G. Cline of the Dominion Hydrographic Survey established stations on the above streams during October, 1912, and frequent readings have been taken subsequently. See miscellaneous measurements on above creeks.

Mesliloet river (upper station) (104).—This station was established October 31, by C. G. Cline; the measuring section is located about 2 miles above the mouth of Brandt creek, and about one-half a mile below the proposed dam site. A vertical staff gauge was driven into the bed of the stream on the right bank at the measuring section and securely braced; measurements are made by wading. The company has applied for 300 second-feet from the Mesliloet.

Hixon creek (105).—The station on Hixon creek was established October 19. The measuring section is located 200 yards from the mouth; all measurements are made by wading; there is a vertical staff gauge, but a small flow leaves the channel above it. The company have applied for 70 second-feet from this creek.

Belknap creek (106).—The station on Belknap creek was established October 21. The measuring section is located at Belknap lake, just below the outlet, and 3 miles from the Mesliloet; measurements are made by wading. A vertical staff gauge is located on the left bank at the measuring section. The company proposes to store water in Belknap lake, which has a capacity of about 2,000 acre-feet.

Brandt creek (107).—The station on Brandt creek was established October 18, 1912. The measuring section and gauge are located about 200 feet from the mouth, above backwaters from the Mesliloet. A vertical staff gauge is located on the left bank. Wading measurements are made. The company have applied for 10 cubic feet from this creek.

Norton creek (108).—The station on Norton creek, a tributary of Brandt creek, was established October 20, 1912. The measuring section is located 200 feet below the outlet of Norton lake, 2,500 feet above the Mesliloet, and two miles from Hastings camp. A vertical staff gauge is driven into the bed of the creek at the outlet of the lake. Measurements are made by wading. The company have applied for 30 second-feet from Norton creek; they also propose to store 10,000 acre-feet in Norton lake.

Young creek (109).—The station on Young creek, a tributary of Brandt creek, was established October 29, 1912. The measuring section is located near the mouth, and below the falls. A vertical staff gauge is located 150 feet above the measuring section. Measurements are made by wading. The banks are high and rocky, and there is only one channel, with a permanent bed. The company have applied for 30 second-feet from Young creek, and also propose to store water in Young lake, a reservoir of 500 acre-feet capacity.

DISCHARGE MEASUREMENTS of Mesliloet River, at mouth, 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Mar. 13...	C. G. Cline.	1046	72	62·4	1·7	1·82	108
July 10...	"	1046	80	154	1·9	2·35	291
Aug. 21...	"	1046	70	78·5	3·4	2·25	264
Oct. 17...	"	1046	140	392	2·8	3·65	1090
Oct. 18...	"	1046	118	350	1·8	2·96	615

DAILY GAUGE HEIGHT AND DAILY DISCHARGE

DAY	MARCH		APRIL		MAY		JUNE		JULY	
	Gauge height	Disch'ge.	Gauge height	Disch'ge.	Gauge height	Disch'ge.	Gauge height	Disch'ge.	Gauge height	Disch'ge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1				160	2·6	414		868		420
2				160		382		854	2·7	466
3			2·0	160		350	3·3	840		485
4				170	2·4	318		807		504
5				180		420		774	2·8	522
6			2·1	194		520		740		504
7				207		620	3·1	706		485
8				220		720		706	2·7	466
9				253		820		706		449
10				246		920	3·1	706		432
11				259		1,020		872	2·6	414
12			2·3	274	3·7	1,130		1,038		366
13	1·82	112		274		1,155	3·8	1,205		320
14		110		274		1,180		1,097	2·3	274
15		108		274		1,200		989		264
16	1·8	107	2·3	274		1,220		880		254
17		107		285		1,240	3·2	772		244
18		107		296		1,255		795	2·2	232
19		107		307		1,270		818		232
20	1·8	107	2·4	318	3·9	1·280	3·3	840		232
21		111		307		1,240		776		232
22		115		296		1,200		712	2·2	232
23	1·85	119		285		1,160		648		246
24		122	2·3	274		1,120		584		260
25		125		290		1,080	2·8	522	2·3	274
26		128		304		1,040		490		274
27	1·9	131	2·4	318		1,000		458		274
28		140		342		955		426	2·3	274
29		150		366	3·4	910		394		260
30	2·0	160		390		896	2·5	364		246
31		160				882			2·2	232

of Mesliloet (Indian) River, at mouth, for 1912.

August.		September.		October.		November.		December.		Day.
Gauge height.	Disch'ge.	Gauge height.	Disch'ge.	Gauge height.	Disch'ge.	Gauge height.	Disch'ge.	Gauge height.	Disch'ge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec. ft.	Feet.	Sec.-ft.	
	232		870		609	3·2	772	2·7	466	1
	232		855	3·1	706	3·2	772	2·7	466	2
2·2	232	3·3	840		664	3·0	642	3·0	642	3
	246		890		622	3·5	980	3·2	772	4
	260		940	2·9	580	3·9	1,280	2·8	522	5
2·3	274	3·5	980		600	3·6	1,055	2·9	580	6
	535		940		621	3·8	1,205	2·7	466	7
	795		900	3·0	642	3·8	1,205	2·6	414	8
3·6	1,055		860		602	4·1	1,425	2·6	414	9
	860		820		562	3·7	1,130	2·5	364	10
	665		780	2·8	522	4·0	1,350	2·8	522	11
2·7	466		740		552	3·8	1,205	3·5	980	12
	715	3·1	706		582	3·5	980	3·7	1,130	13
	960		646		612	3·8	1,205	3·8	1,205	14
3·8	1,205		586	3·0	642	4·8	2,000	3·2	772	15
	1,080		526		625	4·2	1,500	3·0	642	16
	955	2·7	466		610	3·7	1,130	2·9	580	17
	830		432		595	4·0	1,350	3·3	840	18
	705		398	2·9	580	5·4	2,400			19
2·9	580	2·5	364		628	4·1	1,425			20
2·25	253		364		676	4·4	1,650			21
	331		364		724	4·3	1,575			22
	409		364	3·2	772	3·9	1,280			23
	487		364		1,020	3·5	980			24
	565	2·5	364		1,260	3·3	840			25
3·0	642		348	4·2	1,500	3·3	840			26
	709		333		1,350	3·0	642			27
	776	2·4	318		1,200	2·8	522			28
	843		415	3·6	1,055	3·7	466			29
3·4	910		512		1,130	2·6	414			30
	890			3·8	1,205					31

MONTHLY DISCHARGE of Mesliloet River, at mouth, for 1912.

(Drainage area, 75 square miles.)

Month.	DISCHARGE IN SECOND FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
March	160	107	125	1·7	2·0	7,700	
April	390	160	265	3·5	3·9	15,800	
May	1,280	318	933	12·4	14·3	57,400	
June	1,205	364	746	10·0	11·2	44,400	
July	522	232	334	4·4	5·1	20,500	
August	1,205	232	635	8·5	9·8	39,200	
September	980	318	609	8·1	9·0	36,200	
October	1,500	522	776	10·3	11·9	47,700	
November	2,400	414	1,140	15·2	17·0	67,800	
December	1,205	364	654	8·7	10·0	40,200	
The peroid							130

NOTE.—Accuracy, "A" and "C".

MONTE CREEK.

Monte creek is a stream about 20 miles long rising in Monte hills, 5 miles west of Grand Prairie at an elevation of 4,000 feet, and, flowing northerly, discharges into the South Thompson river at Ducks, B.C. It is a stream about 6 feet wide and from 1 foot to 2 feet deep, with a mean velocity of from 0·5 to 4 feet per second. This stream flows through an agricultural district in the Dry Belt, and is a very contentious irrigation stream. Senator Bostock, a large landowner in the vicinity, irrigates hundreds of acres of land in the Monte Creek valley and also bench and bottom lands in the Thompson river valley near the mouth of the creek. Records on this creek are held to divert water from the Monte creek, at a point about 15 miles from the mouth, into Summit lake where it is stored and used, when required, on lands near Grand Prairie in the Salmon River drainage. In 1912 there was plenty of water for all concerned, but in previous years considerable trouble arose due to a scarcity of water. There is a small storage reservoir near the source of Monte creek, with a capacity of 2,000 acre-feet.

The precipitation is about 12 inches throughout the valley, of which about 4 inches is snow. The winters are short and cold and the summers hot and dry. The creek freezes up during the months of December, January and February.

Regular gauging stations were established on Monte creek: (1) Above Bostock's diversion (252). (2) Below diversion to Summit lake (253). (3) Diversion to Summit lake (254).

(1) *Above Bostock's Diversion (252).*—The station on Monte creek above Bostock's diversion was established on May 20, 1911, by C. E. Richardson. The measuring section is located 300 yards above the Bostock headgate, 1½ miles from Ducks and 100 yards from the wagon road, Ducks to Grand Prairie. The gauge is a standard vertical staff near the measuring section on the right bank of the stream. Measurements were made by wading with Price's electric current meter. The channel above and below the station is straight for 50 feet, the water is fairly fast. The right bank is steep for 15 feet to the wagon road. The left bank is low and heavily tim-

Gauge on Monte Creek, near Ducks, B.C.

Making Current Meter Measurement by Wading

bered, but there is no chance of overflow. The bed of the stream is silt at the measuring section and gravel at the gauge. There is only one channel, and its depth is from 1 foot to 3 feet. Three bench-marks were established and referred to the gauge datum.

DISCHARGE MEASUREMENTS of Monte Creek, above Bostock's Diversion, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 20	C. E. Richardson	1,048	15	16·7	1·4	1·45	23·1
May 20	C. G. Cline	1,044	15	19·4	1·2	1·45	24·2
June 28	C. E. Richardson	1·048	8·5	6·9	0·62	0·86	3·68
Aug. 8	"	1,048	6·0	2·4	0·42	0·60	1·00
1912.							
May 8	C. E. Richardson	1,048	15	26·8	1·2	1·50	32·9
" 9	"	1,048	16	31·2	1·3	1·57	39·6
" 15	"	1,048	18	39·4	2·2	2·05	88·8
July 15	"	1,048	8·5	6·7	0·8	1·05	5·3

DAILY GAUGE HEIGHT AND DISCHARGE of Monte Creek, above Bostock's Diversion, for 1911.

Day.	May.		June.	
	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·05	6·1
2			1·0	5·0
3			1·0	5·0
4			0·97	4·6
5			0·97	4·6
6			0·97	4·6
7			0·95	4·3
8			0·95	4·3
9			0·92	3·9
10			0·9	3·6
11			0·9	3·6
12			0·9	3·6
13			0·88	3·4
14			0·90	3·6
15			0·82	2·7
16				2·8
17				2·8
18				2·8
19				2·9
20	1·45	26·0		2·9
21	1·4	22·0		2·9
22	1·42	23·6		3·0
23	1·37	20·0		3·0
24	1·37	20·0		3·0
25	1·35	18·6		3·0
26	1·30	15·3		3·0
27	1·25	12·9		3·1
28	1·22	11·5	0·86	3·2
29	1·2	10·5		3·2
30	1·15	8·8		3·2
31	1·1	7·2		

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MONTHLY DISCHARGE of Monte Creek, above Bostock's Diversion, for 1911.

(Drainage area, 110 square miles.)

Month.	DISCHARGE IN SECOND FEET.				RUN OFF.		RAIN FALL.
	Maximum	Minimum	Mean	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches
June	6·1	2·7	3·6	·03	·03	214	
The period							9

NOTE.—Accuracy, "B."

DAILY GAUGE HEIGHT AND DISCHARGE of Monte Creek, above Bostock's Diversion for 1912.

Days.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.	
	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·39	21·3	1·68	47·0	1·20	10·5		3·1		
2			1·40	22·0		42·0	1·25	12·9		3·3		
3			1·40	22·0	1·58	37·2	1·28	14·3		3·3		
4			1·40	22·0	1·50	30·0	1·25	12·9		3·3	0·86	3·2
5			1·40	22·0	1·48	28·4	1·28	14·3		3·2		
6			1·45	26·0	1·43	23·6	1·28	14·3		3·2		
7			1·50	30·0	1·38	20·7		12·4		3·1	0·88	3·1
8	1·12	7·9	1·51	30·9	1·38	20·7	1·20	10·5		3·1		
9		8·4	1·58	37·2		17·5	1·18	9·8		3·1		
10	1·15	8·8	1·85	65·5	1·28	14·3	1·18	9·8		3·0		
11	1·22	11·5	2·00	83·0		13·1	1·08	7·1		3·0		
12		13·4	2·02	85·4	1·30	22·0	1·10	7·2		3·0		
13	1·30	15·3	2·02	85·4	1·35	26·0	1·08	6·8		2·9		
14		12·5		90·6		30·0		7·2		2·9		
15	1·18	9·8		95·8	1·50	30·0	1·05	6·1		2·8		
16		9·3	2·15	101·0	1·50	30·0	0·98	4·7		2·8		
17	1·15	8·8	2·25	113·5	1·55	34·5	0·98	4·7		2·7		
18		7·3	2·28	117·4	1·58	37·2	0·98	4·7		2·7		
19	1·02	5·4		111·0	1·50	30·0	0·92	3·9		2·6		
20		7·1	2·18	104·6	1·38	20·7	0·95	4·3		2·6		
21		8·8	2·05	89·0		13·9	0·98	4·7	0·80	2·5		
22	1·20	10·5	2·05	89·0	1·40	7·2	0·98	4·7		2·3		
23	1·20	10·5	2·15	101·0		11·7	0·98	4·7		2·3		
24	1·22	11·5		92·0	1·30	15·3	1·25	12·9	0·76	2·2		
25	1·22	11·5	2·00	83·0		14·1	0·95	4·3		2·2		
26	1·28	14·3	2·02	85·4	1·25	13·0	0·95	4·3		2·2		
27	1·28	14·3	1·95	77·0	1·28	13·3	0·95	4·3		2·1		
28	1·22	11·5		68·5	1·25	12·9		3·9	0·78	2·3		
29	1·30	15·3	1·80	60·0	1·25	12·9	0·90	3·6		2·4		
30	1·15	20·7	1·78	57·8		11·7	0·88	3·4		2·3		
31			1·78	57·8				3·4	0·82	2·7		

Monthly Discharge of Monte Creek, above Bostock's Diversion, for 1912.

(Drainage area, 110 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April...	20·7	5·4	10·0	·09	·10	595	
May...	117·4	21·3	69·3	·63	·73	4,260	
June....	47·0	7·2	22·8	·21	·23	1,360	
July....	14·3	3·4	7·5	·07	·08	460	
August.	3·4	2·2	2·8	·02	·02	172	
The period.							12

Note.—Station was maintained during the summer only. The winter conditions are severe, and the creek is frozen for fully four months, during which time the run-off is very small and of little importance for storage.

Accuracy, "A" and "B."

(2) *Monte creek below diversion to Summit Lake (253).*—The station on Monte creek below the diversion to Summit lake was established on May 25, 1911, by C. E. Richardson. The measuring section is 100 yards below the diversion, near T. Graham's, and half a mile west of the Grande Prairie, Monte Creek wagon road, six miles from Grand Prairie. The gauge is a vertical staff 4 inches by 1½ inches by 4·7 feet (cedar), marked in feet and tenths from 3 feet to 7·7 feet, fastened to the right bank of the stream 100 yards below the diversion. Measurements are made with a Price electric current meter and wading equipment. The channel above and below the station is straight for 100 feet, and the water flows with a uniform velocity. The banks are steep and high and sparsely timbered. The bed of the stream is gravelly; there is only one channel, with a depth of from 6 inches to 2·5 feet. Three bench-marks were established and referred to the gauge datum.

Discharge Measurements of Monte Creek, below Summit Lake Diversion, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 25.....	C. E. Richardson	1048	14	13·2	0·7	4·30	9·15
June 15..	W. M. Carlyle	1044	13	9·6	0·5	4·08	4·70
July 10...	"	1044	14	12·8	0·7	4·20	9·12
July 24....	"	1044	13	7·45	0·3	4·00	2·36
Aug. 18....	"	1044	3·5	1·35	0·5	3·80	0·63
1912.							
May 11....	C. E. Richardson.....	1048	15	24·7	3·0	4·70	73
July 15..	"	1048	12	9·1	0·5	4·00	4·8
July 17....	"	1048	11	7·3	0·4	3·93	2·9
Aug. 27....	"	1048	10	4·3	0·4	3·74	1·6

DAILY GAUGE HEIGHT AND DISCHARGE of Monte Creek, below Summit Lake Diversion, for 1911.

Day.	MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.	
	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			4·27	13·4	4·05	3·7	3·95	2·0	3·80	0·4	3·85	0·8
2			4·25	11·8	4·05	3·7	3·92	1·6	3·80	0·4	3·85	0·8
3			4·22	10·4	4·05	3·7	3·90	1·3	3·85	0·8		
4			4·22	10·4	4·05	3·7	3·90	1·3	3·85	0·8		
5			4·20	9·1	4·05	3·7	3·90	1·3	3·85	0·8		
6			4·20	9·1	4·05	3·7	3·95	2·0	3·85	0·8		
7			4·17	8·0	4·10	5·0	4·00	2·7	3·85	0·8		
8			4·15	6·9	4·12	5·9	4·00	2·7	3·80	0·4		
9			4·12	5·9	4·15	6·9	3·97	2·3	3·80	0·4		
10			4·10	5·0	4·20	9·1	3·95	2·0	3·80	0·4		
11			4·10	5·0	4·20	9·1	3·92	1·6	3·80	0·4		
12			4·10	5·0	4·15	6·9	3·90	1·3	3·80	0·4		
13			4·07	4·3	4·12	5·9	3·90	1·3	3·80	0·4		
14			4·07	4·3	4·10	5·0	3·87	1·1	3·80	0·4		
15			4·07	4·3	4·10	5·0	3·87	1·1	3·80	0·4		
16			4·17	8·0	4·05	3·7	3·87	1·1	3·80	0·4		
17			4·12	5·9	4·05	3·7	3·80	0·4	3·85	0·8		
18			4·15	6·9	4·05	3·7	3·80	0·4	3·85	0·8		
19			4·15	6·9	4·05	3·7	3·80	0·4	3·80	0·4		
20			4·12	5·9	4·05	3·7	3·85	0·8	3·80	0·4		
21			4·12	5·9	4·07	4·3	3·85	0·8	3·80	0·4		
22			4·10	5·0	4·05	3·7	3·85	0·8	3·80	0·4		
23			4·10	5·0	4·00	2·7	3·85	0·8	3·80	0·4		
24			4·07	4·3	4·00	2·7	3·80	0·4	3·85	0·8		
25	4·15	6·9	4·05	3·7	4·00	2·7	3·80	0·4	3·85	0·8		
26	4·12	5·9	4·05	3·7	3·97	2·3	3·80	0·4	3·85	0·8		
27	4·15	6·9	4·05	3·7	3·97	2·3	3·80	0·4	3·82	0·6		
28	4·17	8·0	4·05	3·7	3·97	2·3	3·80	0·4	3·82	0·6		
29	4·20	9·1	4·05	3·7	3·95	2·0	3·80	0·4	3·82	0·6		
30	4·22	10·4	4·05	3·7	3·95	2·0	3·80	0·4	3·85	0·8		
31	4·30	15·1			3·95	2·0	3·80	0·4				

MONTHLY DISCHARGE of Monte Creek, below Summit Lake Diversion, for 1911.
(Drainage area, 45 square miles.)

Month	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum.	Mean.	Per sq. mile	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	13·4	3·7	6·2	·14	·16	369	
July	9·1	2·0	4·1	·09	·10	252	
August	2·7	0·4	1·1	·02	·02	68	
September	0·8	0·4	0·6	·01	·01	36	
The period							9

NOTE.—These figures do not represent the true run-off of the drainage area of Monte Creek above this station, since a large proportion of its natural flow is diverted to Summit lake. The freshet flow of Monte Creek for 1911 occurred before the establishment of this station. The run-off during May, 1911 probably was 1,500 to 3,000 acre-feet.

Accuracy, "A."

DAILY GAUGE HEIGHT AND DISCHARGE of Monte creek, below Diversion to Summit lake, for 1912.

Day.	April.		May.		June.		July.		August.		September.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		3·0	4·35	25·0	4·1	7·7	4·0	4·7	4·0	4·7	3·8	2·0
2		3·0	4·35	25·0	4·1	7·7	4·1	7·7	3·9	3·1	3·85	2·5
3		3·0	4·4	30·0	4·05	6·2	4·1	7·7	3·8	2·0	3·8	2·0
4		3·0	4·4	30·0	4·05	6·2	4·0	4·7	3·8	2·0	3·7	1·3
5	3·9	3·1	4·5	43·0	4·05	6·2	4·0	4·7	3·8	2·0	3·7	1·3
6	4·0	4·7	4·5	43·0	4·0	4·7	4·05	6·2	3·8	2·0	3·7	1·3
7	4·1	7·7	4·5	43·0	4·0	4·7	4·05	6·2	3·8	2·0	3·7	1·3
8	4·2	12 4	4·9	110	4·0	4·7	4·10	7·7	3·8	2·0	3·7	1·3
9	4·3	20·0	4·9	110	4·0	4·7	4·05	6·2	3·8	2·0	3·7	1·3
10	4·35	25·0	4·8	92	4·2	12·4	4·05	6·2	3·8	2·0	3·65	1·2
11	4·4	30·0	4·9	110	4·2	12·4	4·08	7·1	3 8	2·0	3·65	1·2
12	4·5	43·0	4·9	110	4·2	12·4	4·1	7·7	3·7	1·3	3·62	1·1
13	4·6	57·0	5·0	130	4·2	12·4	4·1	7·7	3·7	1·3	3·62	1·1
14	4·0	4·7	5·0	130	4·2	12·4	4·1	7·7	3·7	1·3	3·6	1·0
15	4·1	7·7	5·0	130	4·2	12·4	4·1	7·7	3·8	2·0	3·6	1·0
16	4·1	7·7	5·0	130	4·1	7·7	4·0	4·7	3·8	2·0	3·6	1·0
17	4·1	7·7	5·0	130	4·1	7·7	4·0	4·7	5·9	3·1	3·6	1·0
18	4·1	7·7	5·0	130	4·1	7·7	3·95	3·9	3·9	3·1		
19	4·2	12·4	4·6	57	4·1	7·7	4·0	4·7	3·85	2·5		
20	4·2	12 4	4·6	57	4·0	4·7	4·05	16·2	3·8	2·0		
21	4·15	10·0	4·6	57	4·0	4·7	3·9	3·1	3·8	2·0		
22	4·2	12·4	4·6	57	4·0	4·7	3·9	3·1	3·7	1·3		
23	4·2	12·4	4·5	43	4·1	7·7	3·9	3·1	3·7	1·3		
24	4·2	12·4	4·5	43	4·1	7·7	3·9	3·1	3·8	2·0		
25	4·22	13·9	4·5	43	4·1	7·7	5·95	3·9	3·8	2·0		
26	4·2	12·4	4·5	43	4·0	4·7	4·0	4·7	3·7	1·3		
27	4·25	16·2	4·45	36·5	4·0	4·7	4·0	4·7	3·7	1·3		
28	4·3	20·0	4·4	30	4·0	4·7	3·95	3·9	3·7	1·3		
29	4·3	20·0	4·4	30	4·0	4·7	3·9	3·1	3·7	1·3		
30	4·35	25·0	4·4	30	4·0	4·7	3·9	3·1	3·7	1·3		
31			4·35	25			3·9	3·1	3·7	1·3		

MONTHLY DISCHARGE of Monte creek, below diversion to Summit lake, for 1912.
(Drainage area, 45 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	57	30	14·3	·31	·35	851	
May	130	25	67·8	1·51	1·74	4,169	
June	12·4	4·7	7·3	·16	·18	434	
July	16·2	3·1	5·6	·13	·15	344	
August	4·7	1·3	2·0	·04	·05	123	
The period							12

NOTE.—These figures do not represent the natural flow of Monte creek at this point, since a large percentage of the water is diverted into Summit lake above this station. This station was maintained during the irrigation season only. The winter flow is unimportant, even for storage.

Accuracy, "A" and "B."

(3) *Monte creek diversion to Summit lake* (254).—The station on Monte creek diversion to Summit lake was established on May 25, 1911, by C. E. Richardson. The diversion is about half a mile long, and the water flows into the north end of Summit lake. The headgate on Monte creek is about 12 miles from the mouth and 100 yards above the hydrographic station called Monte creek at Graham's ranch.

The measuring section on the diversion is located 75 yards below the headgate, half a mile from Summit lake and 6 miles from Grande Prairie. The gauge is a standard vertical staff fastened to the left abutment of the headgate. All measurements are made with the wading equipment. The channel above and below the measuring section is straight for 25 feet, the bed is rough, and the banks gradually sloping, confining all the water to one channel at all stages.

The gauge was established at the headgate. The water is changed from one channel to the other by moving logs and rocks. So every time the water is changed the gauging section is changed. In 1911 no changes were made; but, due to the continual changing in 1911, no daily discharges were obtained. A new station will be established in 1913.

Discharge Measurements of Monte creek, diversion to Summit lake, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 25	W. M. Carlyle.	1044	4·7	10·2	3·2	1·15	32·7
June 15	"	1044	13·6	6·0	1·5	0·58	8·8
July 10	"	1044	13·5	4·6	1·1	0·39	5·0
July 24	"	1044	6·0	2·4	0·4	0·1	0·9
Aug. 18	"	1044	2·0	0·6	0·4	0·03	0·2
1912.							
May 11	C. E. Richardson.	1048	9·0	7·0	1·6	0·6	10·8
May 15	"	1048	4·0	1·6	1·2	0·31	1·9
July 17	"	1048	5·0	1·5	1·2	0·32	1·7
Aug. 27	"	1049	3·0	0·7	0·6	0·18	0·4

DAILY GAUGE HEIGHT AND DISCHARGE of Monte creek, diversion to Summit lake, for 1911.

Day.	MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·10	30·4	0·20	2·0	0·12	1·1	0·10	0·9	0·10	0·9
2			1·12	31·4	0·20	2·0	0·12	1·1	0·10	0·9	0·10	0·9
3			1·02	26·6	0·20	2·0	0·10	0·9	0·05	0·6		
4			0·95	23·4	0·20	2·0	0·10	0·9	0·05	0·6		
5			0·88	20·3	0·20	2·0	0·10	0·9	0·05	0·6		
6			0·82	17·8	0·20	2·0	0·12	1·1	0·05	0·6		
7			0·89	17·0	0·25	2·7	0·15	1·5	0·05	0·6		
8			0·75	15·1	0·28	3·1	0·15	1·5	0·10	0·9		
9			0·72	13·8	0·30	3·4	0·12	1·1	0·10	0·9		
10			0·70	13·2	0·40	5·1	0·12	1·1	0·10	0·9		
11			0·70	13·2	0·35	4·2	0·10	0·9	0·10	0·9		
12			0·68	12·6	0·30	3·4	0·10	0·9	0·10	0·9		
13			0·65	11·6	0·28	3·1	0·08	0·8	0·10	0·9		
14			0·62	10·7	0·22	2·3	0·05	0·6	0·10	0·9		
15			0·58	9·5	0·22	2·3	0·05	0·6	0·10	0·9		
16			0·40	5·1	0·20	2·0	0·02	0·4	0·10	0·9		
17			0·35	4·2	0·20	2·0	00·1	0·9	0·05	0·6		
18			0·35	4·2	0·20	2·0	00·1	0·9	0·05	0·6		
19			0·32	3·7	0·20	2·0	00·1	0·9	0·05	0·6		
20			0·32	3·7	0·20	2·0	00·1	0·9	0·05	0·6		
21			0·32	3·7	0·22	2·3	00·1	0·9	0·05	0·6		
22			0·30	3·4	0·20	2·0	00·1	0·9	0·05	0·6		
23			0·30	3·4	0·18	1·8	00·1	0·9	0·05	0·6		
24			0·28	3·1	0·10	0·9	00·1	0·9	0·10	0·9		
25	1·15	32·9	0·25	2·7	0·10	0·9	00·1	0·9	0·10	0·9		
26	1·05	28·0	0·22	2·3	0·15	1·5	00·1	0·9	0·10	0·9		
27	1·05	28·0	0·20	2·0	0·15	1·5	00·1	0·9	0·10	0·9		
28	1·05	28·0	0·20	2·0	0·15	1·5	00·1	0·9	0·10	0·9		
29	1·05	28·0	0·20	2·0	0·15	1·5	00·1	0·9	0·10	0·9		
30	1·08	29·5	0·20	2·0	0·15	1·5	00·1	0·9	0·10	0·9		
31					0·15	1·5	00·1	0·9				

MONTHLY DISCHARGE of Monte creek, near diversion to Summit lake, for 1911.

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	30·4	2·0	10·7			637	
July	5·1	1·4	2·2			135	
August	1·4	0·4	0·9			55	
September	0·9	0·6	0·8			48	

NOTE.—The station was continued only during the irrigation season. The creek freezes over for three months in the year.

Accuracy, "C."

Moulton Creek.

Moulton creek (or Deep creek) is a small though somewhat contentious irrigation stream rising in the hills just south of the source of Paul creek, at an elevation of 3,500 feet, and discharging into the South Thompson near Pritchard, B.C., at an elevation of 1,150 feet. Its total drainage area is about 6 square miles, while above the gauging station it is about 5 square miles. At the mouth of the creek, conditions peculiar to the Dry Belt exist, and the precipitation in an average year is about 10 inches. At its source in the Back valley, where the catchment basin is heavily timbered, the rainfall and snowfall combined would, under average conditions, make a total precipitation of about 20 inches. Moulton creek is about 6 miles in length, about 3 feet wide and varies in depth from 1 to 8 inches. The flow is very small, but the creek seldom runs dry since it is no doubt fed by springs and seepage from Paul creek. There is no suitable storage on the creek, although McIvors meadow might be used if the cost were not prohibitive.

The station was established by C. G. Cline on August 26, 1911, and semi-weekly gauge readings were taken till freeze-up in 1911, and during the irrigation season of 1912. The gauge is a vertical staff gauge and is nailed to a 10-inch pine on the right bank of the stream, 100 feet above the highest diversion. Measurements are made 15 feet above the gauge by wading during the higher stages, and by means of floats during low water.

The bed of the stream is of rocks and mud, while the banks are 3 feet high and clear of bushes. There is no danger of over-flow.

The elevations of the two bench-marks are referred to the datum of the gauge.

Discharge Measurements of Moulton Creek River, two miles from mouth, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity	Gauge height.	Discharge.
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
[illegible]	C. G. Cline.					[illegible]	0·3
1912.							
April 16	Cline and Dunn	1056	1·0	0·17	0·4	1·15	0·07
May 29	E. M. Dunn					1·3	1·9

SEMI-WEEKLY GAUGE HEIGHT AND DISCHARGE of Moulton creek, two miles from mouth, for 1911.

Day.	August.		September.		October.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1						
2					1·0	0·0
3						
4			1·0	0·0		
5					1·0	0·0
6						0·01
7			1·0	0·0		0·02
8						0·03
9					1·05	0·05
10						0·07
11			1·0	0·0		0·0
12				0·01	1·1	0·1
13				0·03		0·1
14			1·05	0·05		0·1
15				0·03		0·1
16				0·02	1·1	0·1
17				0·01		0·1
18			1·0	0·0		0·1
19					1·1	0·1
20						0·1
21			1·0	0·0		0·1
22						0·1
23					1·1	0·1
24						0·1
25			1·0	0·0		0·1
26	1·0	0·0			1·1	0·1
27						0·1
28	1·0	0·0	1·0	0·0		0·1
29						0·1
30	1·0	0·0			1·1	0·1
31						0·1

MONTHLY DISCHARGE of Moulton creek, two miles from mouth, for 1911
(Drainage area, 5 square miles.)

Month.	Discharge in Second Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
September	0·05	0·0	0·005	0·001	0·001	0·3	
October	0·1	0·0	·07	·01	·01	4	
The period							10

NOTE.—Station was established August 26, 1911.
Accuracy "C."

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Semi-Weekly Gauge Height and Discharge of Moulton creek, two miles from mouth, for 1912.

Day.	April.		May.		June.		July.		August.		September.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	1·47	9·3		11·2		0·4		0·08	1·05	5·3		0·09
2		9·3	1·0	10·6		0·4	1·07	0·08		0·05	1·1	0·01
3		9·2		9·5	1·2	0·4		0·12	.....	0·05		0·09
4	1·17	9·3		8·4		0·3	1·12	0·16	.....	5·26	1·07	0·07
5		9·3	1·5	7·1		0·2		0·16		0·07		
6		9·3		7·0	1·15	0·2		0·16	1·05	0·07		
7		9·3		6·8		0·2		0·10		0·06		
8	1·2	9·4		6·2		0·2	1·12	0·10	1·2	0·04		
9		9·3	1·45	5·7		0·2		0·16		0·03		
10		9·4		5·0	1·15	0·2		0·10		0·01		
11	1·2	9·4		4·3		0·2		0·16	.....	0·01		
12		9·5		3·6		0·2	1·12	0·16		0·03		
13		9·5	1·65	2·9	1·17	0·3		0·14	1·05	0·03		
14		9·4		2·3		0·3		0·17		0·05		
15	1·2	9·5		2·0		0·4		0·20	1·07	0·05		
16		9·8	1·3	1·9		0·2	1·07	0·08	.....	0·04		
17		1·2		1·8	1·15	0·2		0·06		0·03		
18	1·3	1·6		1·6		0·2	1·05	0·05		0·03		
19	1·4	4·2		1·5		0·2		0·06	1·0	0·0		
20		4·2	1·3	1·0	1·15	0·2		0·07	.....	0·0		
21		4·2		1·4		0·15		0·07		0·0		
22	1·4	4·2		1·2		0·10	1·07	0·08	1·0	0·0		
23		5·8	1·25	1·0		0·10		0·09		0·0		
24		7·4		1·0	1·05	0·05		0·09		0·0		
25	1·55	9·0		1·0		0·07	1·1	0·10	.....	0·0		
26	1·6	10·6		1·0		0·05		0·09	1·03	0·03		
27		10·4	1·25	1·0	1·05	0·05		0·08	.....	0·03		
28	1·6	10·6		0·8		0·05		0·07	.....	0·05		
29	1·65	12·2		0·6		0·05		0·06	1·03	0·02		
30		11·7	1·2	0·4		0·05	1·05	0·05	.....	0·05		
31				0·4				0·05	.....	0·07		

MONTHLY DISCHARGE of Moulton creek, two miles from mouth, for 1912.

(Drainage area, 5 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAIN-FALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	12·2	0·3	3·46	0·69	0·77	206	
May	11·2	0·4	3·57	0·71	0·82	220	
June	0·4	0·05	0·19	0·04	0·045	11	
July	0·16	0·05	0·10	0·02	0·023	6	
August	0·07	0·0	0·03	0·006	0·007	2	
The period							12 to 15

NOTE.—Station was maintained during irrigation season only
Accuracy, "C."

MURRAY CREEK (263).

Murray creek rises in the Murray mountains at an elevation of 4,000 feet and flows southeast, discharging into Thompson river at Spence's Bridge at an elevation of 700 feet. It is about 10 miles long, about 15 feet wide, varying in depth from 0·5 feet to 3·0 feet, and with a mean velocity of from 1 to 3 feet per second. The precipitation is small, not exceeding 20 inches; the summers are dry and hot, and the winters not severe, with 4 or 5 feet of snow. Murray creek flows down from Murray mountain, winding in and out of little canyons, and over little falls and rapids. The valley is small and rough, being covered with small underbrush and timber.

A quarter of a mile from the mouth there is a fall of over 200 feet. At this point the flow of the creek is diverted through a rock tunnel and the full head utilized for the development of power to light the town of Spence's bridge. The water is also used for irrigation and domestic purposes.

The station was established by C. E. Richardson on September 15, 1911, and is located above all diversions, 400 yards from Thompson river and three-quarter of a mile from Spence's Bridge.

The gauge is a vertical staff gauge, 5 feet long, and is on the right bank of the stream, 50 yards above the mouth of the tunnel. The bed of the stream is rocky, and the flow is confined to one channel by the walls of the canyon through which it flows.

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DISCHARGE MEASUREMENTS of Murray creek, above diversions, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.
1912.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 4.	C. F. Richardson.	1,048	17	17·1	1·4	0·78	23·5
May 21.	C. G. Cline	1,046	19·	32·0	1·8	1·50	58·1
June 28.	B. Corbould.	1,053	8·3	6·0	2·1	0·68	12·8
July 18.	"	1,044	7·3	4·9	2·7	0·65	13·3
Aug. 2.	"	1,044	7·5	3·8	2·3	0·5	8·8
1911.							
Sept. 15	"						9·8
Oct. 24.	"						10·5

[1] No gauge heights, gauge destroyed.

WEEKLY GAUGE HEIGHT AND DAILY DISCHARGE

Day.	MAY.		JUNE.		JULY.		AUGUST.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1				30		20		11
2			1·0	28		20		11
3				27		21		10·5
4				26		22	0·55	10·5
5	0·9	23		26		23		10·5
6		24		25		24		10·5
7		25		25	0·95	25		10·5
8		26		24		24		10·5
9		28	0·9	23		24		10·5
10		30		23		23		10·5
11		31		22		23	0·55	10·5
12	1·1	33		22		22		11
13		33		21		22		12
14		34		20	0·85	21		13
15		34		20		19		14
16		35	0·8	19		17		15
17		35		20		15		16
18		36		20	0·65	14	0·75	17·0
19	1·15	36		21		15		16
20		36		21		16		15
21		37		22	0·75	17		14
22		37		22		16		13
23		38	0·9	23		16		12
24		38		22		15		11
25		39		22		14	0·55	10·5
26	1·2	39		21		14		10·5
27		38		21		13		10·5
28		37		20	0·6	12		10·5
29		36		20		12		10·5
30		34	0·8	19		12		10·5
31		32				11		10·5

of Murray creek, above diversions, for 1912.

September.		October.		November.		December		Day
Gauge height.	Discharge	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
0·55	10·5		9		1·0	0·45	7·5	1
	10·5		10		9		7·5	2
	10·5		10		9		7·5	3
	10·5		10	0·5	9·0		7·5	4
	10·5		10		10		7·5	5
	10·5	0.55	10·5		10		7·5	6
	10·5		10		11		7·5	7
0·55	10·5		10		11	0·45	7·5	8
	10·5		10		12		7·5	9
	10		10	0·6	12·0		7·5	10
	10		9		12		7·5	11
	10		9		12		7·5	12
	9		9		11		7·5	13
	9	0·5	9·0		11		7·5	14
0·5	9		9		11	0·45	7·5	15
	9		9		10		7·5	16
	9		10		10		7·5	17
	9		10	0·55	10·5		7·5	18
	9	0·55	10·5		10		7·5	19
	9		10·5		10		7·5	20
	9		10·5		10		7·5	21
0·5	9		10·5		9	0·45	7·5	22
	9		10·5		9		7·5	23
	9		10·5	0·5	9·0		7·5	24
	9		10·5		9		7·0	25
	9		10·5		9		7·0	26
	9	0·55	10·5		8		6·5	27
	9		10·5		8		6·5	28
0·5	9		10·5		8		6·0	29
	9		10		7·5	0·4	6·0	30
			10				6·0	31

MONTHLY DISCHARGE of Murray creek, above diversions, for 1912.

(Drainage area, 36 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAIN-FALL.
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	39	23	33·5	·93	1·1	2,060	
June	30	19	22·5	·63	·7	1,340	
July	25	11	18·1	·5	·58	1,110	
August	17	10·5	11·9	·33	·38	732	
September	10·5	9·0	9·5	·26	·29	565	
October	10·5	9·0	10·0	·28	·32	615	
November	12·0	7·5	9·9	·28	·31	589	
December	7·5	6·0	7·3	·2	·23	449	
The period							15

NOTE.—Accuracy, "C."

NAHATLATCH RIVER (127).

Nahatlatch river rises in the mountains north of Harrison lake, outside the Railway Belt, at an elevation of about 6,000 feet, and discharges into Fraser river at an elevation of 360 feet. It is part of the Fraser drainage. Douglas creek flows into the Nahatlatch from the south, and Log creek from the north. These two streams are close together and only a short distance below the lakes. The drainage area of the Nahatlatch at the upper measuring section, which is above the two tributaries, is 200 square miles; and the area above the mouth of the stream is 250 square miles. One very small tributary is used for irrigation, but the water of the main stream is not used in any way at present. The stream however, has a good site for the development of water-power.

The upper part of the watershed of the Nahatlatch is rough and mountainous, with some peaks on which the snow remains until quite late in the fall. The country is timbered, and some of the timber is very good. Near the lakes the valley is quite wide, and for several miles above the lake the river flows quite slowly and sometimes overflows its banks and floods the hay meadows at the head of the lakes. The lakes themselves are at an elevation of 900 feet. There are four lakes in all, three of them being at practically the same elevation, while the last is from 15 to 20 feet below. The three upper lakes are, together, 7 miles long, while the lower is about half a mile, with half a mile of rapids between. The width varies from one-quarter of a mile to a mile. The hills rise quite steeply from the water's edge except at the mouth of two or three creeks, where there are deltas. Snowslides are quite frequent, and it is very hard to keep a trail open along the lakes. The lake is quite deep in most parts. There is good fishing in the lakes and in the river.

Below the lakes the river is a series of rapids, falling 550 feet in 8 miles. It is for this reason that no attempt has been made to run logs in the river. But with this fall it would be quite possible to develop a large amount of power. The lakes would provide the necessary storage. The great drawback to the scheme is the necessity for about 7 miles of flume and pipe line, necessitating a large expense for construction and considerable attention during operation to prevent damage from slides and falling timber. Probably as much as 30,000 horse-power could be developed if desired.

There is some land being cultivated near the mouth of the Nahatlatch river. Fruit seems to do fairly well there. There is one homesteader about 4 miles up the valley, and there is no one beyond him. A few years ago, part of the hay meadow at the head of the lakes was taken up as a homestead, but a big log jam in the river caused the flooding of the meadows and the house was washed away; since that time no attempt has been made to cultivate that land. The use of the lakes for storage for power purposes will mean that this land will be flooded, and it is merely a matter of deciding which will be of greater value.

Gauging stations were established at two places on the Nahatlatch. One is at the outlet of the lakes and gives the flow from them; the other is 2 miles below the lakes and gives the total flow of the stream, including the two tributaries, Douglas creek and Log creek, which enter about half a mile below the lakes. The river is very rapid and the bed thickly strewn with large boulders, but by carefully choosing the section, blasting out some of the worst boulders and putting up cables and cars, two fairly good metering stations were obtained. Part of this work was done by engineers of the Canadian Pacific Railway Company who were investigating the power possibilities of the stream. Gauges were established and are being read by Chas. Nicholson, a prospector, who is the only person living in the Nahatlatch valley. He is four miles from the farthest gauge, and makes the trip once a week. The stations were established on February 26, 1912, and weekly gauge readings have been taken at both stations continuously since that date. The discharges at the upper station have been worked out; but at the lower station this cannot be done until some more meter measurements are made at the proper stages of the river.

The upper station is 8 miles west of Keefer station, and 200 yards east of the lowest of the Nahatlatch lakes. There is a chain gauge of No. 12 steel Jack chain with a six-pound sash weight. The chain runs over a pulley on the end of a log, supported against two trees, and overhanging the stream; it is referred to three permanent bench-marks. For the meter measurements there is a half-inch steel cable stretched across the stream and supported by trees on each bank, a substantial car is suspended from cable by means of two heavy snatch blocks and the engineer can thus place himself directly over any part of the section and take measurements with a meter suspended by its cable. The channel above the station is straight for 100 feet, with the water flowing smoothly. About 400 feet above the section there are rapids when the water leaves the lake. Below the section the channel is straight for 100 feet and then the rapids commence again. The right bank is 100 feet high, with a steep slope, the left bank is 50 feet high, with a fairly steep slope and with bushes and trees above the high-water mark. The bed of the stream is covered with rocks and boulders and these make it rather difficult to get accurate measurements. There is only one channel, about 4 feet deep at low water.

Discharge Measurements of Nahatlatch River, below Nahatlatch lakes, 1912.

Date.	Hydrographer	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Feb. 25....	C. G. Cline.	1,046	65	256	1·6	3·45	417
July 18....	"	1,046	105	530	3·6	6·58	1,930
Nov. 28...	"	1,048	80	381	2·1	4·75	817

WEEKLY GAUGE HEIGHT AND DAILY DISCHARGE

Day.	FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.		JULY.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	.....	.....	395	3·95	520	.....	980	.....	1,945	.....	1,385
2	.....	.....	.....	390	.....	525	.....	1,055	6·4	1,800	.....	1,440
3	.....	.....	.....	385	.....	530	.....	1,130	.....	2,040	.....	1,500
4	.....	.....	3·25	380	.....	535	.....	1,200	.....	2,280	.....	1,560
5	.....	.....	.....	380	.....	540	5·6	1,270	.....	2,525	.....	1,620
6	.....	.....	.....	380	.....	550	.....	1,490	.....	2,770	.....	1,675
7	.....	.....	.....	380	.....	555	.....	1,710	.....	3,010	6·3	1,730
8	.....	.....	.....	380	4·1	560	.....	1,930	.....	3,250	.....	1,830
9	.....	.....	.....	375	.....	575	.....	2,150	8·7	3,490	.....	1,910
10	.....	.....	.....	375	.....	590	.....	2,370	.....	3,320	.....	2,005
11	.....	.....	3·20	375	.....	605	.....	2,590	.....	3,150	.....	2,100
12	.....	.....	.....	375	.....	620	7·8	2,815	.....	2,980	.....	2,190
13	.....	.....	.....	375	.....	635	.....	2,760	.....	2,810	.....	2,280
14	.....	.....	.....	375	4·4	660	.....	2,700	.....	2,640	7·2	2,370
15	.....	.....	.....	375	.....	680	.....	2,640	.....	2,470	.....	2,280
16	.....	.....	.....	375	.....	705	.....	2,585	6·95	2,295	.....	2,190
17	.....	.....	.....	375	.....	730	.....	2,530	.....	2,240	.....	2,100
18	.....	.....	3·20	375	.....	710	.....	2,470	.....	2,190	6·7	2,010
19	.....	.....	.....	375	.....	785	7·4	2,415	.....	2,140	.....	2,010
20	.....	.....	.....	370	.....	810	.....	2,470	.....	2,090	.....	2,010
21	.....	.....	.....	370	4·8	830	.....	2,530	.....	2,040	6·7	2,010
22	.....	.....	.....	370	.....	825	.....	2,585	.....	1,990	.....	2,075
23	.....	.....	.....	370	.....	820	.....	2,640	6·6	1,940	6·6	1,940
24	.....	.....	.....	365	.....	810	.....	2,700	.....	1,850	.....	1,825
25	.....	.....	3·10	365	.....	805	.....	2,760	.....	1,760	.....	1,710
26	3·45	415	.....	390	.....	795	7·8	2,815	.....	1,670	.....	1,590
27	.....	410	.....	410	.....	790	.....	2,670	.....	1,590	.....	1,475
28	.....	405	.....	435	4·7	785	.....	2,525	.....	1,500	5·75	1,360
29	.....	400	.....	455	.....	855	.....	2,380	.....	1,420	.....	1,400
30	.....	.....	.....	470	.....	925	.....	2,235	5·7	1,330	.....	1,440
31	.....	.....	.....	495	.....	.....	.....	2,090	.....	.....	.....	1,480

of Nahatlatch River, below Nahatlatch lakes, for 1912.

August.		September.		October.		November.		December.		Day.
Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
	1,515	4·7	785		600		545	4·45	680	1
	1,550		790		625		530		660	2
	1,590		795		650	3·9	510		640	3
6·15	1,625		800		675		510		620	4
	1,580		810		700		515		600	5
	1,535		815	4·55	720		520		580	6
5·95	1,490		825		690		525	4·1	560	7
	1,660	4·8	830		660		530		540	8
	1,820		860		630		535		525	9
	1,990		895		600	4·0	535		510	10
6·9	2,155		930		570		570		495	11
	2,065		965		540		610		480	12
	1,975		1,000	3·9	510		645		465	13
	1,865		1,030		550		680		450	14
	1,785	5·25	1,060		585		715	3·55	430	15
	1,700		1,010		620		750		430	16
	1,615		960		655	4·7	785		435	17
6·0	1,525		910		690		815		440	18
	1,560		855		725		845		445	19
	1,600		800	4·65	760		880		450	20
	1,640		750		740		910		455	21
	1,680	4·5	700		720		950	3·7	460	22
	1,720		680		700		980		470	23
	1,760		660		680	5·15	1,010		480	24
6·4	1,800		640		660		960		490	25
	1,655		620		640		910		505	26
	1,510		600	4·3	625		860		515	27
	1,365		580		610	4·75	805		525	28
	1,220	4·1	560		590		760	4·0	535	29
	1,075		580		575		720		535	30
	930				560				535	31

MONTHLY DISCHARGE of Nahatlatch River, below Nahatlatch lakes, for 1912.
(Drainage area, 200 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.	
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
March	495	365	389	1·9	2·2	23,900
April	925	520	690	3·4	3·8	41,000
May	2,815	980	2,230	11·1	12·8	137,000
June	3,490	1,330	2,284	11·4	12·7	136,000
July	2,370	1,360	1,822	9·1	10·5	112,000
August	2,155	930	1,631	8·1	9·3	100,000
September	1,060	560	803	4·0	4·5	47,000
October	760	510	640	3·2	3·7	39,400
November	1,010	510	714	3·6	4·0	42,500
December	680	430	518	2·6	3·0	31,850

NOTE.—Drainage area of Nahatlatch area has been estimated from best available maps, which are very inaccurate. The run-off of 66 inches in ten months seems to show that the drainage area is larger than 200 square miles.

Accuracy, "A" and "C."

NED'S CREEK.

Ned's creek is a small irrigation stream rising in the hills on the south side of south Thompson river, 8 miles east of Ducks, at an elevation of 2,500 feet. The stream flows in a northwesterly direction, discharging into south Thompson river at an elevation of 1,150 feet, in township 19-14-6.

Ned's creek is about 5 miles long, from 4 feet to 8 feet wide and from 6 inches to 1 foot deep. The drainage area is about 4 square miles. The precipitation is about 10 inches. The summers are very hot and dry, the winters are not severe (—20 F.) and there is very little snow.

Ned's creek is used for irrigation and domestic purposes. The stream is over-recorded and contentious. There are small parcels of land up the valley, but most of the water is used to irrigate the land in the Thompson valley in the vicinity.

The gauging station was established on May 31, 1911, by C. E. Richardson. The gauge is a standard staff, and located 30 feet above Senator Bostock's diversion, about half a mile above the wagon road from Ducks to Chase. Readings have been taken during the irrigation seasons of 1911 and 1912.

DISCHARGE MEASUREMENTS of Ned's creek, above Bostock's diversion, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 31	C. E. Richardson	1048	3·5	1·1	2·0	0·95	2·4
1912.							
May 14	C. E. Richardson	1048	6·0	3·5	2·4	1·23	8·4

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Daily Gauge Height and Discharge of Ned's creek above Bostock's diversion, for 1911.

	June.	
	Gauge height.	Discharge.
	Feet.	Sec.-ft.
1	0·95	2·6
2	0·92	2·2
3	0·89	1·8
4	0·78	0·9
5	0·8	1·0
6	0·86	1·5
7	0·85	1·4
8	0·82	1·2
9	0·82	1·2
10	0·81	1·1
11	0·8	1·0
12	0·81	1·1
13	0·78	0·9
14	0·76	0·8
15	0·75	0·7
16	0·7	0·5
17	0·72	0·6
18	0·7	0·5
19	0·68	0·4
20	0·68	0·4
21	0·65	0·3
22	0·70	0·5
23	0·70	0·5
24	0·68	0·4
25		
26		
27		
28		
29		
30		

Monthly Discharge of Ned's creek, above Bostock's diversion, for 1911.

(Drainage area, 4 square miles.)

Month.	Discharge in Second-Feet.				Run Off.	
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
June	2·6	0·3	1·0	0·25	0·28	60

Note.—Accuracy, "D."

DAILY GAUGE HEIGHT AND DISCHARGE of Ned's creek, above Bostock's diversion, for 1912

Day.	MAY.		JUNE.		JULY.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·85	1·4	0·68	0·4
2			0·82	1·2	0·70	0·5
3			0·82	1·2	0·72	0·6
4			0·82	1·2	0·75	0·8
5			0·80	1·0	0·75	0·8
6			0·80	1·0	0·75	0·8
7			0·80	1·0	0·72	0·6
8			0·78	0·9	0·70	0·5
19			0·75	0·8	0·65	0·3
10			0·75	0·8	0·60	0·2
11			0·75	0·8	0·55	0·2
12			0·78	0·9	0·52	0·1
13			0·78	0·9	0·52	0·1
14	1·28	8·2	0·90	1·9	0·52	0·1
15	1·32	10·8		1·6	0·52	0·1
16	1·30	10·3		1·2	0·50	0·1
17	1·20	7·7	0·78	0·9	0·50	0·1
18	1·08	4·9	0·75	0·8	0·50	0·1
19	1·08	4·9	0·72	0·6	0·58	0·2
20	1·05	4·3	0·70	0·5	0·65	0·3
21	1·02	3·7	0·70	0·5	0·65	0·3
22	0·98	3·0	0·68	0·4	0·62	0·3
23	0·98	3·0	0·65	0·3	0·55	0·2
24	0·98	3·0	0·60	0·2	0·52	0·1
25	1·05	4·3	0·60	0·2	0·52	0·1
26	1·00	3·3	0·65	0·3	0·50	0·1
27	0·98	3·3	0·62	0·3	0·50	0·1
28	0·95	2·6	0·65	0·3	0·50	0·1
29	0·92	2·2		0·3	0·50	0·1
30	0·92	2·2		0·4	0·50	0·1
31	0·9	1·9			0·50	0·1

MONTHLY DISCHARGE of Ned's creek, above Bostock's diversion, for 1912.
(Drainage area, 4 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
June	1·4	0·2	0·8	0·20	0·22	48
July	0·8	0·1	0·27	0·07	0·08	17

NOTE.—The compilations are based on only two measurements.

Nelson Creek (246).

Nelson creek has its source south of Barnes lake at an elevation of 2,000 feet. It discharges into Thompson river from the east, 5 miles south of Ashcroft, at an elevation of 900 feet, and is part of the Thompson River drainage. The watershed is small (only about 6 square miles) and water is diverted into the stream from Barnes lake, for use in irrigation. Nelson creek is in the driest part of the Dry Belt, with a mean annual precipitation of about 8 inches. The summers are hot and dry; the winters cold and dry.

Nelson creek carries a small run-off from a limited watershed south of Barnes lake, and is dry most of the year. The natural flow of the stream is supplemented by water which is diverted from Barnes creek. This water is run into Barnes lake in the first place, where it is stored until required. It can be run from Barnes lake back into Barnes creek or on into another small lake which feeds Nelson creek. From this second lake it may be run into Nelson creek or may be run directly into irrigation ditches.

A gauging station was established on Nelson creek on May 11, 1912, and daily gauge readings were taken to September 12 of the same year. This covers the irrigation season. The station is above all diversions both into the stream and out of it, and so gives the natural flow of the stream. But, of course, 1912 was a particularly wet year in that district; often there is no flow at all after June. The gauge is at Williams ranch, near Ashcroft, 25 feet above the diversion from Barnes lake, and 50 feet above the highest diversion from the creek, and half a mile from the main road along the east side of the Thompson. The gauge is a vertical staff, 5½ feet long, nailed to the roots of a small poplar tree on the right bank of the creek, and is referred to a bench-mark. The meter measurements were made at a section 20 feet below the gauge with the meter on a rod and the observer standing on two logs thrown across the stream for a bridge. There is a small fall 25 feet above the section, and swift water in a straight channel for 25 feet below. The banks are high and wooded and not liable to overflow. The bed of the stream is clean and rocky, with the water 6 inches deep in the freshet.

Discharge Measurements of Nelson Creek, above diversions, 1912.

Date	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 11	C. G. Clinc	1046	4·5	1·9	2·8	0·90	5·6
June 21	C. G. Clinc and B. Corbould	1046	2·5	0·5	0·6	0·27	0·4
July 8	B. Corbould	1044	4·0	1·4	2·0	0·55	2·9
July 27	"	1044	3·0	0·9	1·4	0·35	1·3
Aug. 17	"	1044	2·5	0·5	0·9	0·3	0·5

GAUGE HEIGHT AND DISCHARGE of Nelson Creek, above diversions, for 1912.

Day.	MAY.		JULY.		AUGUST.		SEPTEMBER.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1				1·4		1·4	0·3	0·6
2				1·4		1·4	0·4	1·4
3				1·4		1·4	0·4	1·4
4				1·4		1·4	0·3	0·6
5			0·4	1·4		1·4	0·3	0·6
6				1·5		1·4	0·3	0·6
7				1·6		0·6	0·3	0·6
8				1·8		0·6	0·3	0·6
9				2·0		0·6	0·3	0·6
10			0·5	2·2		0·6	0·3	0·6
11	0·9	5·7		2·2		0·6	0·3	0·6
12				2·2		0·6	0·3	0·6
13	0·8	4·8	0·5	2·2		0·6		
14				2·0		0·6		
15	0·7	4·0		1·7		0·6		
16			0·4	1·4		0·6		
17	0·6	3·1		1·2	0·3	0·6		
18				1·0		0·6		
19				0·8	0·3	0·6		
20	0·5	2·2	0·3	0·6	0·3	0·6		
21	0·5	2·2		0·8	0·3	0·6		
22				1·0	0·3	0·6		
23	0·4	1·4		1·2	0·3	0·6		
24			0·4	1·4	0·3	0·6		
25	0·4	1·4		1·4	0·3	0·6		
26				1·4	0·3	0·6		
27	0·3	0·6	0·4	1·4	0·3	0·6		
28			0	1·4	0·3	0·6		
29	0·3	0·6		1·4	0·3	0·6		
30				1·4	0·3	0·6		
31	0·3	0·6		1·4	0·3	0·6		

MONTHLY DISCHARGE of Nelson Creek, above diversion, for 1912.

(Drainage area, 5 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
July	2·2	0·6	1·5	0·2	0·2	92
August	1·4	0·6	0·8	0·1	0·1	49
The period						140

NOTE. Accuracy, "D."

Nicola River (210 and 211.)

Nicola river is 45 miles long and rises in Nicola lake, at an elevation of 2,020 feet, and discharges into Thompson river near Spence's Bridge, at an elevation of 700 feet. The mean annual precipitation over the whole drainage area is very small, not exceeding 15 inches. The area of the watershed is 2,650 square miles, 1,150 square miles of which lies above the mouth of Coldwater river. Nicola lake is 10 miles long and from half a mile to 1½ miles wide. It is fed chiefly by the following streams:—

(1) Quilchena creek which rises in the hills 15 miles south of Nicola lake, at an elevation of 3,000 feet.

(2) Upper Nicola river, which rises in the Trepange plateau, some 25 miles southeast of Nicola lake, at an elevation of 4,000 feet. Chaperon and Douglas lakes are both tributaries of this stream.

(3) Stump lake, and its tributaries, 10 miles northeast of Nicola lake.

(4) Moore creek, which rises in the hills 10 miles north of Nicola lake.

From Nicola lake, the Nicola flows in a southwesterly direction for 7 miles to Merritt, where it is joined by Coldwater river. The Coldwater is a large and flashy stream, draining 360 miles of country south of Merritt, and rising on the east slope of Anderson River mountain at an elevation of 4,000 feet. From Merritt the Nicola flows in a Northwesterly direction for 40 miles to discharge into Thompson river near Spence's Bridge at an elevation of 650 feet. At Lower Nicola, 35 miles from the mouth, Guichon creek enters. Guichon creek is a very contentious irrigation stream, and drains 475 square miles of land, a large percentage of which is suitable for cultivation. (*See* Gazeeter on Guichon creek). At Canford, 29 miles from the mouth, Spius creek flows into the Nicola. Spius creek drains 160 square miles of land east of Canford, rising 10 miles northwest of the source of Coldwater river, at an elevation of 3,500 feet.

The Nicola valley is a famous ranching country, the rolling hills being very suitable for grazing lands; possibly the most celebrated district in the valley is the Douglas Lake country; here some 100,000 acres of land are controlled by one company, known as the Douglas Lake Cattle Co.

Good agricultural districts are scattered all through the Nicola drainage. On Guichon creek alone, probably 20,000 acres of land are under cultivation. The land around Nicola lake is all taken up. All through the valley, however, in dry seasons, there is a scarcity of water, not so much due to the lack of water but to the lack of system in utilizing the water, and poor ditches.

A considerable amount of mining is carried on in the Nicola valley. At Merritt, three coal mines are in operation and, in the vicinity, several rich gypsum claims have been recorded.

Practically all water-power possibilities on Nicola river proper have been eliminated by the presence of the C.P.R. Nicola Valley branch. This railroad follows the river between Spence's Bridge and Merritt, and any development would interfere with the present right of way. There is small industrial power on Spius creek, but any installation would be expensive. Coldwater river affords similar opportunities to Spius creek, but the power all through the valley is very limited.

There are two stations on Nicola river. The upper one, at Merritt (211), was established on June 17, 1911, by C. E. Richardson, and continuous daily gauge readings were obtained until the end of December, 1912.

The measuring section is located on the upstream side of the highway bridge, immediately below the mouth of the Coldwater river. Merritt station is slightly over one mile distant by the C.P.R. track. Measurements are made by cable suspension.

The gauge is a 6-foot standard vertical gauge, nailed to the right abutment of the bridge on its upstream side.

The stream is confined between the bridge abutment to one channel, whose bed is gravelly.

The elevation of the south rail of the C.P.R. Spence's Bridge to Nicola branch at the crossing of the road to Collettsville, is 15·03 feet above the datum of the gauge.

The station at the mouth of Nicola river (210) was established on June 19, 1911, by C. E. Richardson. The measuring section is located 200 yards from the mouth of the river on the upstream side of the highway bridge on the Spence's Bridge—Nicola road, 1¼ miles from Spence's Bridge. Measurements are made by cable suspension. The gauge is painted in white on a large sloping rock on the right bank of the stream, about 600 yards above the measuring section. Each subdivision of the gauge was set by a level, so no bench-marks were necessary.

The river is always confined to one channel, whose bed is of rock and gravel with no vegetation. During high stages of Thompson river, water is backed up to the measuring section but not to the gauge.

DISCHARGE MEASUREMENTS of Nicola River, near mouth, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Aug. 8	C. E. Richardson	1048	120	244	3·3	2·65	816
Sept. 15	"	1048	113	151	2·5	1·78	386
Oct. 24	"	1048	113	116	1·5	1·30	176
1912.							
Mar. 29	C. G. Cline	1046	105	127	1·9	2·00	242
May 3	C. E. Richardson	1048	128	348	4·6	4·40	1,600
May 27	C. G. Cline, B. Corbould	1046	140	658	6·1	6·60	3,990
July 3	B. Corbould.	1044	130	399	3·2	4·20	1,298
July 20	"	1044	120	260	2·6	3·10	667
Aug. 10	"	1044	115	167	1·9	2·25	321

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DAILY GAUGE HEIGHT AND DISCHARGE of Nicola River, near mouth (Lower Gauge), for 1911.

Day.	August.		September.		October.		November.		December.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	2·4	690	1·62	319	1·55	290	1·3	175	1·8	
2	2·5	740	1·62	319	1·5	265	1·3	175	1·8	
3	2·6	790	1·7	355	1·45	240	1·25	155	1·7	
4	2·4	690	1·72	264	1·4	220	1·3	175	1·7	
5	2·3	640	1·8	400	1·4	220	1·3	175	1·8	
6	2·35	665	1·78	391	1·45	240	1·3	175	1·7	
7	2·7	840	1·7	355	1·42	229	1·3	175	1·7	
8	2·65	815	1·62	319	1·45	240	1·3	175	1·8	
9	2·5	740	1·5	265	1·42	229	1·3	175	1·8	
10	2·4	690	1·5	265	1·42	229	1·3	175	1·7	
11	2·3	640	1·45	240	1·40	220	1·3	175	1·7	
12	2·2	590	1·4	220	1·37	206	1·3	175	1·7	
13	2·12	550	1·55	290	1·35	198	1·3	175	1·8	
14	2·08	530	1·6	310	1·3	175	1·3	175	1·8	
15	2·02	500	1·78	391	1·3	175	1·3	175	1·8	
16	1·95	470	1·85	422	1·3	175	1·3	175	1·7	
17	1·95	470	1·85	422	1·3	175	1·3	175	1·7	
18	1·95	470	1·78	391	1·3	175	1·3	175	1·7	
19	1·9	445	1·78	391	1·3	175	1·3	175	1·7	
20	1·95	470	1·75	378	1·3	175	1·4	220	1·7	
21	1·92	454	1·72	364	1·3	175	1·5	265	1·8	
22	1·92	454	1·72	364	1·3	175	1·5	265		
23	1·90	445	1·72	364	1·3	175	1·6	310	2·2	
24	1·88	436	1·7	355	1·3	175	1·7	355	2·0	
25	1·85	422	1·67	342	1·3	175	1·6	310	1·9	
26	1·82	409	1·65	330	1·3	175	1·7	355	1·7	
27	1·78	391	1·62	319	1·3	175	1·7	355	1·8	
28	1·75	378	1·6	310	1·3	175	1·62	319	2·0	
29	1·72	364	1·6	310	1·3	175	1·70	355	1·8	
30	1·7	355	1·57	295	1·3	175	1·8	400	1·7	
31	1·68	346			1·3	175				

MONTHLY DISCHARGE of Nicola River, near mouth (Lower Gauge), for 1911.

(Drainage area, 2,650 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
August	815	346	545	0·20	0·23	33,500	
September	422	220	335	0·13	0·145	19,900	
October	290	175	200	·076	·088	12,300	
November	400	155	227	·084	·093	13,500	
The period							11

NOTE.—The mean discharge in November is inclined to be in excess of the correct mean, due to partial ice conditions existing in the latter part of November.

Accuracy, "C."

GAUGE HEIGHTS AND DAILY DISCHARGE of

Day.	APRIL.		MAY.		JUNE.		JULY.	
	Gauge heigh.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1				1,200	5·9	3,100	3·9	1,150
2				1,300	5·8	2,970	4·1	1,280
3				1,400	5·7	2,840	4·2	1,360
4				1,500	5·6	2,720	4·0	1,200
5	2·6	430	4·5	1,600	5·6	2,720	3·9	1,130
6		450		1,930	5·6	2,720	3·8	1,060
7		470		2,260	5·8	2,970	3·8	1,060
8		490		2,600	6·0	3,230	3·7	1,000
9		510		2,940	6·0	3,230	3·6	940
10		530		3,280	6·0	3,230	3·5	880
11		550		3,600	5·8	2,970	3·5	880
12		570	6·5	3,920	5·6	2,720	3·5	880
13		590		3,940	5·6	2,720	3·6	940
14	3·0	610		3,960	5·4	2,490	3·8	1,060
15		620		3,980	5·2	2,270		970
16		630		4,000	4·8	1,870	3·5	880
17		640		4,020	5·0	2,050		800
18		650		4,044	5·0	2,050		730
19		670	6·6	4,060	5·2	2,270	3·1	660
20		690	6·8	4,340	5·2	2,270		635
21	3·2	710	6·9	4,480	5·3	2,280	3·0	610
22		740	7·0	4,630	5·3	2,380		585
23		770	6·5	3,920	5·0	2,050	2·9	560
24		800	6·4	2,780	4·7	1,780		530
25		820	6·6	4,060	4·4	1,520		500
26		840	6·6	4,060	4·3	1,440	2·7	470
27		860	6·6	4,060	4·2	1,360		445
28	3·5	880	6·5	3,920	4·1	1,280		420
29		990	6·3	3,640	3·9	1,130	2·5	390
30		1,000	6·1	3,360	3·8	1,060		390
31			5·9	3,100			2·5	390

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Nicola River, near mouth, for 1912.

August.		September.		October.		November.		December.		
Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	Day.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
	375		300	1·8	195		240	2·3	330	1
2·4	360	2·2	300		195		240		330	2
	370		315	1·8	195	2·0	240	2·3	330	3
	380	2·3	330		205		270		315	4
2·5	390		315	1·9	215	2·2	300	2·2	300	5
	390	2·2	300	1·9	215		330		300	6
2·5	390				215	2·4	360	2·2	360	7
	390			1·9	215		290		270	8
2·5	390				215	1·9	215	2·0	240	9
	370		.....	1·9	215	2·0	240		220	10
	350				215		230	1·8	195	11
2·3	330			1·9	215	1·9	215		185	12
	380				215		230	1·7	175	13
2·6	430	.....	.....	...	215	2·0	240		165	14
	450	.....	.....	1·9	215		270	1·6	155	15
2·7	470				230	2·2	300		155	16
	530			2·1	360	2·4	360	1·6	155	17
	600				330		335		155	18
3·1	660			2·2	300	2·6	430	1·6	155	19
	520			2·3	330		410		155	20
2·5	390				315	2·5	390	1·6	155	21
	375			2·2	300		375			22
2·4	360				270	2·4	360			23
	340		.....	2·0	240		345			24
	320				240	2·3	330			25
2·2	300			2·0	240		330			26
	300				240	2·3	330			27
2·2	300				240		315			28
	300	1·8	195		240	2·2	300			29
2·2	300				240		315			30
	300				240					31

MONTHLY DISCHARGE of Nicola River, near mouth, for 1912.
(Drainage area, 2,650 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	1,000	430	673	·25	·28	40,000	
May	4,630	1,200	3,319	1.25	1·44	204,000	
June	3,230	1,060	2,326	·88	·98	138,000	
July	1,360	390	799	·3	·35	49,100	
August	660	300	391	·15	·17	24,000	
September							
October	360	195	244	·09	·10	15,000	
November	430	215	306	·11	·12	18,200	
December	330	155	226	0·08	0·09	13,900	
The period							13

NOTE. Accuracy, "B" and "C."

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DISCHARGE MEASUREMENTS of Nicola River, near Merritt, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
July 11	C. E. Richardson	1048	78	262	2·7	6·24	715
Aug. 9	"	1048	70	308	1·6	5·50	308
Sept. 18	"	1048	68	180	1·4	5·27	253
Oct. 27	"	1048	50	153	0·5	4·75	75
1912.							
May 2	"	1048	89	270	2·3	6·02	640
May 25	C. G. Cline	1046	115	471	4·4	7·42	2,090
July 4	B. Corbould	1044	56	288	2·6	6·31	760
July 23	"	1044	54	267	1·4	5·50	374
Aug. 13	"	1044	46	202	0·9	5·02	193

Daily Gauge Height and Discharge of Nicola River, near Merritt, for 1911.

Day.	June.		July.		August.		September.		October.		November.		December.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1...	..		6·65	1,060	5·5	350	5·05	175	4·95	145	4·65	60	4·9	130
2...			6·6	1,020	5·55	370	5·05	175	4·95	145	4·65	60	4·85	115
3...			6·55	980	5·5	350	5·1	190	4·9	130	4·7	70	4·8	100
4...			6·5	940	5·5	350	5·15	210	4·9	130	4·7	70	4·8	100
5...			6·5	940	5·5	350	5·2	230	4·85	115	4·7	70	4·8	100
6...			6·55	980	5·55	370	5·2	230	4·85	115	4·7	70	4·8	100
7...			6·5	940	5·6	390	5·15	210	4·8	100	4·7	70	4·75	85
8...			6·4	870	5·6	390	5·15	210	4·8	100	4·65	60	4·75	85
9...			6·3	800	5·5	350	5·1	190	4·8	100	4·65	60	4·7	70
10...			6·3	800	5·45	330	5·05	175	4·75	85	4·6	50	4·75	85
11...			6·2	730	5·4	310	5·0	160	4·75	85	4·6	50	4·75	85
12...			6·2	730	5·4	310	5·0	160	4·75	85	4·6	50	4·75	85
13...			6·2	730	5·35	290	5·05	175	4·7	70	4·55	40	4·75	85
14...			6·2	730	5·3	270	5·05	175	4·7	70	4·55	40	4·75	85
15...			6·2	730	5·3	270	5·0	160	4·7	70	4·55	40	4·75	85
16...			6·2	730	5·3	270	5·0	160	4·7	70	4·65	60	4·75	85
17...			6·15	695	5·3	270	5·1	190	4·7	70	4·7	70	4·75	85
18...			6·1	660	5·25	250	5·3	270	4·75	85	4·8	100	4·75	85
19...	6·9	1,290	6·05	630	5·2	230	5·2	230	4·75	85	4·9	130	4·75	85
20...	6·8	1,190	6·0	600	5·2	230	5·1	190	4·75	85	4·9	130	4·7	70
21...	6·8	1,190	5·9	540	5·2	230	5·15	210	4·8	100	5·0	160	4·75	85
22...	6·8	1,190	5·8	480	5·2	230	5·1	190	4·8	100	5·0	160	4·8	100
23...	6·7	1,100	5·8	480	5·2	230	5·0	160	4·8	100	4·95	145	4·9	130
24...	6·7	1,100	5·75	455	5·2	230	5·05	175	4·8	100	4·95	145	4·8	100
25...	6·7	1,100	5·7	430	5·15	210	5·05	175	4·8	100	4·9	130	4·65	60
26...	6·8	1,190	5·7	430	5·15	210	5·0	160	4·75	85	4·85	115	4·65	60
27...	6·75	1,145	5·65	410	5·1	190	5·0	160	4·75	85	4·8	100	4·65	60
28...	6·7	1,100	5·6	390	5·1	190	4·95	145	4·75	85	4·7	70	4·65	60
29...	6·6	1,020	5·55	370	5·1	190	4·95	145	4·7	70	4·75	85	4·65	60
30...	6·7	1,100	5·5	350	5·1	190	4·95	145	4·7	70	4·8	100	4·65	60
31...	..	..	5·5	350	5·1	190	..	..	4·65	60	..	..	4·65	60

MONTHLY DISCHARGE of Nicola River, near Merritt, for 1911.

(Drainage area, 1,500 square miles.)

Month.	DISCHARGE IN SECOND FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
July	1,060	350	677	45	·5	41,600	
August	390	190	277	·18	·21	17,000	
September	270	145	184	·12	·13	10,900	
October	145	60	93·4	·06	·07	5,740	
November	160	40	85·3	·06	·07	5,070	
December	130	60	85·2	·06	·07	5,240	
The period							11

NOTE.—Accuracy, "B."

GAUGE HEIGHTS AND DAILY DISCHARGE of

Day.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY		JUNE.	
	Gauge height.	Dis. charge	Gauge height.	Dis- charge	Gauge height.	Dis- charge	Gauge height.	Dis- charge	Gauge height.	Dis- charge	Gauge height.	Dis- charge
	Feet.	Sec.-ft	Feet.	Sec.-ft.	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft
1....	4·65	60	5·05	175	5·0	160	5·2	230	6·0	600	7·15	1,585
2....	4·65	60	5·0	160	5·0	160	5·3	270	6·05	630	7·15	1,585
3....	4·65	60	5·0	160	5·2	230	5·3	270	6·15	695	7·1	1,520
4....	4·65	60	4·95	145	5·15	210	5·35	290	6·2	730	7·1	1·520
5....	4·65	60	4·95	145	4·95	145	5·35	290	6·3	800	7·1	1,520
6....	4·65	60	5·0	160	4·9	130	5·4	310	6·4	870	7·15	1,585
7....	4·65	60	5·05	175	5·0	160	5·4	310	6·5	940	7·1	1,520
8....	4·65	60	5·1	190	5·0	160	5·4	310	6·8	1,190	7·1	1,520
9....	4·65	60	5·05	175	5·0	160	5·4	310	7·2	1.650	7·1	1,520
10....	4·65	60	5·0	160	5·0	160	5·45	330	7·0	1·400	7·05	1,460
11....	4·75	85	5·0	160	4·95	145	5·55	370	7·0	1,400	7·05	1,460
12....	4·9	130	5·0	160	4·95	145	5·55	370	7·05	1,460	7·05	1,460
13....	5·1	190	5·0	160	4·95	145	5·55	370	7·25	1,725	7·0	1,400
14....	5·4	310	5·0	160	4·9	130	5·55	370	7·2	1,650	6·95	1,345
15....	5·3	270	5·05	175	4·9	130	5·55	370	7·15	1,585	6·86	1,240
16....	5·15	210	5·1	190	4·9	130	5·55	370	7·1	1,520	6·75	1,145
17....	4·95	145	5·05	175	4·9	130	5·6	390	7·05	1,460	6·8	1,190
18....	4·85	115	5·05	175	4·9	130	5·6	390	7·0	1,400	6·8	1,190
19....	4·85	115	5·05	175	4·9	130	5·6	390	7·0	1,400	6·8	1,190
20....	4·8	100	5·05	175	4·9	130	5·6	390	7·4	1,864	6·85	1,240
21....	4·8	100	5·05	175	4·9	130	5·6	390	7·75	2,580	6·8	1,190
22....	4·85	115	5·05	175	4·95	145	5·6	390	7·4	1,960	6·7	1,100
23....	4·9	130	5·1	190	4·95	145	5·6	390	7·3	1,800	6·65	1,060
24....	5·0	160	5·05	175	5·0	160	5·65	410	7·35	1,880	6·6	1,020
25....	5·05	175	5·0	160	5·0	160	5·65	410	7·4	1,960	6·5	940
26....	4·95	145	5·0	160	5·0	160	5·7	430	7·45	2,045	6·45	305
27....	4·95	145	5·0	160	5·05	175	5·7	430	7·5	2,130	6·4	870
28....	4·95	145	5·0	160	5·1	190	5·75	455	7·45	2,045	6·35	835
29....	5·1	190	.....	190	5·1	190	5·85	510	7·3	1,800	6·3	800
30....	5·05	175	....		5·1	190	5·9	540	7·25	1,725	6·3	800
31....	5·05	175	....		5·15	210	.....	.....	7·15	1,585	.....	.....

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Nicola River, near Merritt, for 1912.

July.		August.		September.		October.		November.		December.		Day.
Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge	
Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	
6·3	800	5·15	210		110		40	4·6	50	4·85	115	1
6·4	870		210	4·9	130	4·55	40		50		130	2
6·3	800	5·15	210		130		40	4·6	50	4·95	145	3
6·2	730		200	4·9	130	4·55	40		50		110	4
6·2	730	5·1	190		130	.....	48	4·6	50	4·7	70	4
6·15	695		180	4·9	130	4·6	50		55		60	5
6·1	660	5·05	175		145	.....	50	4·65	60	4·6	50	7
6·05	630		175	5·0	160	4·6	50		55		50	8
6·05	630	5·05	175		145		55	4·6	50	4·6	50	9
6·05	630		185	4·9	130	4·65	60		55		50	10
6·1	660	5·1	190		115		60	4·65	60	4·6	50	11
6·05	630		175	4·8	100	4·65	60		80		50	12
6·05	630	5·0	160		90	.....	60	4·8	100	4·6	50	13
6·0	600		160	4·75	85	4·65	60		100		55	14
	570	5·0	160		80	....	65	4·8	100	4·65	60	15
5·9	540		185	4·7	70	4·7	70		100		60	16
	500	5·15	210		60		70	4·8	100	4·65	60	17
5·75	455		200	4·6	50	4·7	70		130		70	18
	420	5·1	190		45	.....	90	5·0	160	4·75	85	19
5·6	390		190	4·55	40	4·85	115		150		80	20
	370	5·1	190		45		90	4·95	145	4·7	70	21
5·5	350		170	4·6	50	4·7	70		140		65	22
5·5	350	4·95	145		50		70	4·9	130	4·65	60	23
	340		140	4·6	50	4·7	70		130		55	24
	340	4·9	130		50		70	4·9	130	4·6	50	25
5·45	330		120	4·6	50	4·7	70		120		50	26
	300	4·85	115		45		65	4·85	115	4·6	50	27
5·3	270		110	4·55	40	4·65	60		115		50	28
	250	4·8	100		40		60	4·85	115	4·5	50	29
5·2	230		90	4·55	40	4·65	60		115		50	30
	220	4·75	85				55			4·6	50	31

MONTHLY DISCHARGE of Nicola River, near Merritt, for 1912.

(Drainage area, 1,500 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
January	310	60	127	·08	·09	7,810	
February	190	145	169	·11	·12	9,720	
March	230	130	157	·10	·11	9,650	
April	540	230	368	·24	·27	21,900	
May	2,580	600	1,502	1·0	1·15	92,200	
June	1,585	800	1,257	·84	·94	75,000	
July	870	220	514	·34	·39	31,600	
August	210	85	165	·11	·13	10,100	
September	160	40	84·5	·06	·07	5,030	
October	115	40	62·4	·04	·05	3,840	
November	160	50	95·3	·06	·07	5,670	
December	145	50	66·1	·04	·05	4,060	
The year	2,580	40	380	·25	3·44	276,580	13

NOTE.—Accuracy, "B."

NIKAIA CREEK (134).

Nikaia creek has its source in the Cantilever mountains, at an elevation of 3,000 feet, and discharges into the Fraser river, near Lytton, at an elevation of 500 feet. The precipitation is small, not exceeding 20 inches; the summers are dry and very hot, and the winters are not severe, with 3 feet or 4 feet of snow. Nikaia creek is about 7 miles long and from 5 to 10 feet wide. Its drainage area is 7 square miles. Its depth varies from 0·5 feet to 2 feet. The valley is small and rough, with no agricultural land excepting near the mouth, where some 50 acres are taken up. This land is irrigated from the creek.

The mean flow of Nikaia creek is about 5 second-feet, and its maximum probably about 50 second-feet.

A station was established on Nikaia creek on September 23, 1911, by C. E. Richardson, and was located half a mile from the creek's mouth, below the bridge on which the trail crosses. The creek runs between high banks, and is confined to one channel. The gauge is a standard vertical staff gauge, 5 feet long, and is located on the right bank of the stream, 15 feet above the bridge. The stream was not considered of sufficient importance to warrant the continuance of gauge readings. Three meter measurements were made at different stages of the stream. (*See* miscellaneous measurements on Nikaia creek.)

NISKONLITH CREEK (249).

Niskonlith creek is a stream about 10 miles in length, 4 to 10 feet in width and varies from a few inches to two feet in depth. Its drainage area is 50 square miles. Its source is in the hills of township 22, range 14, west of the 6th meridian, the northern slope of which feeds McGillvary creek, an important tributary of Louis creek. Niskonlith creek is little known and is, as yet, unused above Niskonlith lake, an ideal

storage reservoir, two miles from South Thompson river, at an elevation of 1,620 feet. The Indians of the Niskonlith reserve are the principal users, and the flow is well regulated by a dam installed by the Indian Department. It is capable of raising the level of Niskonlith lake, whose area is 1,000 acres, 8 feet, thus impounding 8,000 acre-feet which is, however, much in excess of the normal run-off of the stream. Since the lake was dammed and its level raised, damage is done to hay land in lot 836, by seepage. The normal precipitation in the Niskonlith watershed is about 15 to 20 inches per annum.

There is sufficient water in Niskonlith creek for all users, and suggestion has been made that some of it might be applied to land in the Pemberton and Moulton creek valleys.

A drop of over 500 feet in 2 miles between Niskonlith lake and the South Thompson indicated the possibility of a small power development. The mean flow, however, is very small, but it might be augmented by diversion from a tributary of Adams lake.

The station was established on August 26, 1911, by C. G. Cline, and semi-weekly gauge readings taken during the remainder of 1911 and the whole of the 1912 irrigation season. The station is located about half mile above the highway along South Thompson river and half a mile below Niskolith lake; it is also half mile below the intake for the Indian Reserve irrigation ditch. The gauge is a 3-foot standard gauge, nailed to an 8-inch birch on the right bank of the stream. It is nearly opposite an old deserted cabin which stands on the flat. Measurements are made by wading. The banks are 3 to 5 feet in height, and the stream is confined to one channel which varies in depth from a few inches to two feet. There are three bench-marks, whose elevations are referred to the datum of the gauge.

Discharge Measurements of Niskonlith Creek, at mouth, 1911-12.

Date.	Hydrographer.	Meter No.	Width	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Aug. 28.	C. G. Cline	1,046	10·0	9·2	0·50	0·66	4·4
1912.							
April 17.	E. M. Dann, C. G. Cline	1,046	1·0	0·15	0·60	0·30	0·1
May 20.	E. M. Dann	1,044	8·0	17·9	3·7	1·92	66·9

GAUGE HEIGHT AND DISCHARGE of Niskonlith Creek, at mouth, for 1911.

Day.	August.		September.		October.		November.		December.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1				4·2	0·6	3·0		5·3		
2			0·65	4·2		2·9	0·7	5·3	0·67	4·6
3				4·2		2·8		5·3		
4				4·2		2·7		5·3		
5			0·65	4·2	0·57	2·6	0·7	5·3		
6				4·0		2·5		5·0		
7				3·8		2·2		4·8		
8				3·7		2·0		4·5		
9				3·6	0·52	1·7	0·65	4·2		
10			0·62	3·5		1·8		3·8		
11				3·5		1·9		3·4		
12			0·62	3·5		2·0	0·6	3·0		
13			0·62	3·4	0·55	2·2		2·9		
14				3·3		2·2		2·8		
15				3·2	0·55	2·2		2·7		
16				3·1		3·0		2·6		
17			0·6	3·0		3·8	0·57	2·5		
18				3·0		4·6		3·0		
19				3·0		5·3	0·62	3·5		
20			0·6	3·0		6·0		4·1		
21				3·0	0·75	6·7		4·7		
22				3·0	0·75	6·7	0·7	5·3		
23				3·0		6·2		5·3		
24			0·6	3·0		5·9		5·3		
25				3·0		5·6	0·7	5·3		
26				3·0	0·7	5·3		5·3		
27				3·0		5·3		5·3		
28	0·65	4·2	0·6	3·0		5·3		5·3		
29				3·0	0·7	5·3		5·3		
30				3·0		5·3	0·7	5·3		
31						5·3				

MONTHLY DISCHARGE of Niskonlith Creek, at mouth, for 1911.

(Drainage area, 50 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
September	4·2	3·0	3·4	0·07	0·08	202	
October	6·7	1·7	3·9	0·08	0·09	240	
November	5·3	2·5	4·4	0·09	0·10	262	
The period							12

NOTE.—Station was established August 28; artificial control.
Accuracy "B."

Gauge Height and Discharge of Niskonlith Creek, at mouth, for 1912.

Day.	April.		May.		June.		July.		August.		September.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		15·0		52		69	1·05	18	0	0·3		0·6
2	1·0	15·0		48	1·9	66		18	0·3	0·1		0·6
3		15·0	1·55	44		66		18		0·5		0·6
4		15·0		47		66	1·05	18		1·0		0·6
5		15·0	1·65	50		66		18		1·4	0·42	0·6
6	1·0	15·0		52	1·9	66		18		1·8		0·7
7		15·0		54		64	1·05	18		2·2		0·8
8		15·0		56		62		5·3		2·6		0·8
9	1·0	15·0		58		59		5·3	0·6	3·0	0·45	0·9
10	Dam closed.	7·5	1·8	59		56		5·3		3·0		0·9
11		0·1		60		53	0·7	5·3	0·35	0·3		0·9
12	0·3	0·1		62		50		4·3		0·5		0·9
13		0·1		64	1·6	47		3·3		0·7	0·45	0·9
14		0·1	1·9	66		46		2·3		0·8		
15		0·1		67	1·55	44		1·3	0·45	0·9		
16	0·3	0·1		68		44		0·3		1·0		
17		0·1		69		43	0·35	0·3		1·2		
18		0·1	1·95	70		42		0·3	0·5	1·4		
19	0·3	0·1	.....	78		42		0·3		1·3		
20	.....	0·1	1·92	67	1·5	41	0·37	0·3		1·2		
21	0·3	0·1	1·95	70		41		0·3		1·1		
22		0·1		71	1·5	41		0·4		1·0		
23		0·1		72		31		0·4	0·45	0·9		
24		0·1		74		21	0·4	0·4		0·8		
25	0·8	8·1	2·05	76	0·9	11·5		0·4		0·6		
26		27·0		76		18		0·4	0·1	0·4		
27		56·0		76	1·2	24	0·4	0·4		0·4		
28	1·9	66·0	2·05	76		22		0·4		0·5		
29		61·0		76		20	0·4	0·4	.....	0·5		
30		56·0	2·05	76		19		0·4	0·42	0·6		
31				72				0·4		0·6		

Monthly Discharge of Niskonlith Creek, at mouth, for 1912.

(Drainage area, 50 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per square mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	66	0·1	14·0	0·28	0·31	830	
May	76	44	63·4	1·3	1·5	3,960	
June	69	11·5	33·7	0·89	0·99	2,660	
July	18	0·3	5·3	0·11	0·13	326	
August	3	0·1	1·0	·20	0·3	61	
The period							14

Note.—Artificial control by dam on lake. This station was maintained during the irrigation season only, the flow during the remainder of the year is important only for domestic purposes, being of little value for storage. Winter conditions exist during December, January and February.

Accuracy, "B."

No. 2 Creek (420).

No. 2 creek has its source in the Selkirk mountains, at an elevation of from 6,000 to 9,000 feet, and discharges into Upper Columbia river 9 miles below lake Windermere, at an elevation of 2,709 feet. It is part of the Upper Columbia drainage; the drainage area is at present indeterminate, as there are no reliable maps of the vicinity. It is probably about 150 square miles. The headwaters of the creek have an annual precipitation of about 60 inches, principally snow. Toward the mouth, the creek passes through the arid Windermere district, where the precipitation is about 15 inches annually, and the winter conditions very severe.

From the mouth of the creek to the lower wagon road (1½ miles) the stream flows through the bottom lands of the Columbia valley, which are flooded at high water in June and July. Above the crossing the creek runs through a box canyon half mile long, 30 feet wide and 150 feet deep, in which there is a fall of 50 feet. At the head of the canyon there is a direct fall of 135 feet (measured by aneroid). The banks at the head of the canyon are of solid rock, 80 feet high and 30 feet wide. Above the falls the canyon continues for about a mile, when the country opens out a little. Two miles above the head of the canyon the creek forks, No. 3 creek coming in from the north. No. 3 creek carries more water than the main creek above the forks. It flows through a rolling country, mostly timbered, but in which several ranchers have settled. No. 2 creek, above the fork, flows through a rough mountainous country for 6 miles.

Irrigation is practised in the Columbia valley, and the water of No. 2 creek can be used for this purpose. Mr. Forster, a large landowner in the district, built a dam, 80 feet high, at the head of the falls in order to raise water to some of his bench lands. When the water reached the desired height, the dam failed. He is now constructing an irrigation flume with the intake on No. 2 creek, about 2 miles above the forks.

A water-power development is practicable on this stream. The flow is more uniform than on other streams in this vicinity. The maximum for 1912 occurred during the latter part of June, and was 1,110 c.f.s. The mean flow from June to the end of October was 500 c.f.s. The estimated minimum flow in the latter part of February is 50 c.f.s. By constructing a dam at the head of the falls a head of 250 feet could be obtained. There is no good natural storage reservoir on the stream, although the suggested dam would give good pondage and forebay.

The hydrographic station on No. 2 creek is situated at the highway bridge on the road from Athalmer, about 1½ miles from the mouth. The gauge is a vertical staff gauge, 7 feet long, and is fastened to the abutment on the lower right hand side. The gauge is graduated in feet and tenths. Bench-marks were established and referred to the zero of the gauge. The gauge was read daily by a neighbouring rancher. Measurements were made at the upper side of the bridge. The section was not very good, owing to the swift water and uneven nature of the stony creek bed.

Discharge Measurements of No. 2 Creek, at highway bridge, near Forster's ranch, 1912.

Date	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 29....	H. C. Hughes.....	1055	32	64	4·9	0·84	314
June 13.....	"	1055	53	112	6·6	1·70	741
July 3.....	"	1055	54	114	6·0	1·68	689
July 24.....	"	1055	57	116	6·4	1·70	745
Sept. 28...	C. E. Richardson.....	1055	32	43	4·7	0·40	203

DAILY GAUGE HEIGHT AND DISCHARGE of No. 2 Creek, at highway bridge near Forster's ranch, for 1912.

Day.	May.		June.		July.		August.		September.		October.		November.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·6	240	1·6	670		805	0·8	300	0·6	240	0·3	190
2			0·6	240	1·8	805	1·8	805	1·0	370		245	0·3	190
3			0·55	230	1·65	700	1·7	735	0·85	320	0·3	190		
4				225	1·6	670	1·9	875	1·0	370	0·4	205		
5			0·6	240	1·7	735	1·7	735	0·8	300	0·3	190		
6			0·6	240	1·7	735	1·5	610	0·8	300		190		
7			0·8	300		735		610	0·6	210	0·3	190		
8			1·0	370	1·7	735	1·5	610		270	0·4	205		
9			1·2	455	1·6	670	1·7	735	0·8	300	0·3	190		
10			1·35	530	1·65	700	1·6	670	1·0	370		190		
11			1·35	530	1·7	735	1·5	610	0·9	335		190		
12			1·4	555	1·7	735	1·3	505	0·9	335	0·3	190		
13			1·7	735	2·0	950	1·3	505	0·8	300		185		
14				680	1·8	805	1·1	440	0·8	300	0·2	175		
15			1·5	610	1·8	805	1·9	875		270	0·3	190		
16			1·3	505	1·8	805	1·9	875	0·6	240	0·3	190		
17			1·5	610	1·5	610	1·3	505	0·6	240	0·5	220		
18			1·7	735	1·6	670	1·2	455	0·8	300	0·3	190		
19			1·9	875	1·6	670	1·1	410		275		190		
20			2·0	950	1·7	735	1·0	370	0·65	255		175		
21			1·9	875	1·8	805	1·0	370		240	0·2	175		
22			2·0	950	1·7	735	1·4	555	0·5	220	0·3	190		
23			2·1	1,030	1·8	805	1·4	555	0·55	230	0·3	190		
24			2·2	1,110	1·65	700	2·0	950	0·6	240	0·3	190		
25			2·2	1,110	1·6	670	1·8	805		230	0·4	205		
26			2·2	1,110	1·7	735	1·7	735	0·5	220	0·4	205		
27			2·2	1,110	1·6	670	1·7	735	0·3	190	0·3	190		
28			1·8	805	1·5	610	1·3	505	0·4	205	0·3	190		
29			1·6	670	1·7	735		330	0·2	175	0·3	190		
30	0·8	300	1·7	735	1·7	735	1·0	370	0·5	220	0·3	190		
31	0·7	270			1·8	805	0·7	270			0·3	190		

MONTHLY DISCHARGE of No. 2 Creek, Highway Bridge, near Forster's ranch for 1912.

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	1,110	230	646			38,400	
July	950	610	732			45,000	
August	950	270	611			37,600	
September	370	175	272			16,200	
October	240	175	194			11,900	
The period							35

NOTE.—Station established May 30, 1912. Stream frozen over early in November, 1912. No. 2 creek is much more steady in its flow than the other tributaries of the Columbia in this vicinity. The estimated minimum flow (in the month of March) is 50 c.f.s.

Accuracy, "B."

OREGON JACK CREEK (208).

Oregon Jack creek rises north of the headquarters of Hat creek, at an elevation of 4,000 feet, and discharges into the Thompson river 7 miles below Ashcroft, at an elevation of 980 feet. It is part of the Thompson drainage. The natural area of its watershed is 34 square miles, but in 1912 water was run into Oregon Jack creek from Hat creek, thus practically increasing the watershed area. The water is used for irrigation. The stream is in the Dry Belt, with a mean annual precipitation of from 8 to 10 inches. It is dry and hot in the summer, and cold and dry in the winter. Sage bushes and prickly pears grow in the lower altitudes.

A ditch and flume line has been constructed to divert water from Upper Hat creek into a storage reservoir in the pass between Oregon Jack creek and Hat creek. There is a good site for a large reservoir there, though a big earth dam would be required. There is only a small dam at present. The conflicting applications for the use of this site have interfered with its proper development. From the reservoir the water is fed as required into Oregon Jack creek and follows the natural bed of the stream for several miles. There is a small diversion about 5 miles from the mouth of the creek, which takes the water over to some lands on Minnaberriet creek. The main supply, however, is used on Basque ranch, on the bank of the Thompson river. Even with the diversion from Hat creek, as managed at present, there is not sufficient water; if the supply of water were larger there is a great deal of land in the vicinity which could be irrigated from Oregon Jack creek.

A gauging station was established on the stream, about a mile from the mouth, and just above the main diversion for the Basque ranch. This station measures the natural flow of the stream, together with the water which is diverted from Hat creek. There is a diversion 5 miles up the stream and, when the water is being taken out there, it should be added to the flow at the station to give the total flow. Gauge readings have been taken from April to September, 1912. The gauge is a 5-foot vertical staff, nailed to a tree on the right bank, about 200 feet above the diverting dam, and 150 yards below the bridge where the Yale-Cariboo wagon road crosses the stream. The meter measurements are made by wading.

SESSIONAL PAPER No. 25f

DISCHARGE MEASUREMENTS of Oregon Jack Creek, above Hammond's diversion, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Oct. 2..	Cline and Smith	1046	6·0	2·2	0·9	0·88	2·0
1912.							
May 7.....	C. G. Cline.....	1046	7·0	2·65	1·3	1·00	3·6
May 12.....	"	1046	7·0	2·2	1·7	1·08	5·4
June 20.....	Cline and Corbould.	1046	7·0	4·6	1·7	1·10	7·1
July 9.....	B. Corbould.....	1044	7·5	5·5	2·5	1·29	13·6
July 29.....	"	1044	7·5	5·7	2·1	1·25	12·1
Aug. 16.....	"	1044	7·5	3·6	2·2	1·23	8·1

GAUGE HEIGHT AND DISCHARGE of Oregon Jack Creek, above Hammond's diversion, for 1911.

	OCTOBER.	
	Gauge height.	Discharge.
	Feet.	Sec.-ft.
1		
2	0·9	2·2
3	0·9	2·2
4	0·9	2·2
5	0·9	2·2
6	0·9	2·2
7	0·9	2·2
8	0·9	2·2
9	0·9	2·2
10	0·9	2·2
11	0·9	2·2
12	0·9	2·2
13	0·9	2·2
14	0·9	2·2

DAILY GAUGE HEIGHT AND DISCHARGE of Oregon Jack Creek, above Hammond's diversion, for 1912.

Day.	April.		May.		June.		July.		August.		September.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		2·2	0·9	2·2							1·15	7·6
2		2·2	0·9	2·2							1·15	7·6
3		2·2	0·9	2·2							1·15	7·6
4	0·9	2·2	0·9	2·2							1·15	7·6
5	0·9	2·2	0·9	2·2							1·15	7·6
6	0·9	2·2	0·9	2·2							1·1	5·8
7	0·9	2·2	1·0	3·5							1·1	5·8
8	0·9	2·2	1·0	3·5							1·05	4·6
9	0·9	2·2	1·0	3·5							1·05	4·6
10	0·9	2·2	1·1	5·8			1·1	5·8			1·0	3·5
11	0·9	2·2	1·1	5·8			1·2	9·5			1·0	3·5
12	0·9	2·2	1·1	5·8			1·2	9·5			0·95	2·8
13	0·9	2·2	1·1	5·8	1·1	5·8	1·1	5·8			0·95	2·8
14	0·9	2·2	1·1	5·8	1·1	5·8	1·1	5·8			0·9	2·2
15	0·9	2·2	1·1	5·8	1·1	5·8	1·1	5·8				
16	0·9	2·2	1·1	5·8	1·1	5·8	1·1	5·8				
17	0·9	2·2	1·1	5·8	1·1	5·8						
18	0·9	2·2	1·1	5·8	1·1	5·8			1·25	11·8		
19	0·9	2·2	1·1	5·8	1·1	5·8			1·25	11·8		
20	0·9	2·2	1·1	5·8	1·1	5·8			1·25	11·8		
21	0·9	2·2	1·1	5·8	1·2	9·5			1·25	11·8		
22	0·9	2·2	1·1	5·8	1·3	14·0			1·25	11·8		
23	0·9	2·2		5·8	1·1	5·8			1·25	11·8		
24	0·9	2·2		5·8	0·9	2·2			1·25	11·8		
25	0·9	2·2		5·8	0·9	2·2			1·2	9·5		
26	0·9	2·2		5·8	0·9	2·2			1·2	9·5		
27	0·9	2·2		5·8					1·2	9·5		
28	0·9	2·2		5·8					1·2	9·5		
29	0·9	2·2		5·8					1·2	9·5		
30	0·9	2·2		5·8					1·2	9·5		
31				5·8					1·2	9·5		

MONTHLY DISCHARGE of Oregon Jack Creek, above Hammond's diversion, for 1912.

(Drainage area, 6 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	2·2	2·2	2·2	0·4	0·46	131	
May	5·8	2·2	4·9	0·8	0·9	301	
The period							9

NOTE.—Gauge readings during remainder of irrigation season not continuous. Accuracy, "C" and "D."

Ottertail River (413).

Ottertail river has its source in the Ottertail range of the Rocky mountains, 9 miles southeast of Field, at an elevation of from 6,000 to 9,000 feet and, flowing in a northerly direction, discharges into Kicking Horse river, 6 miles west of Field, at an elevation of 3,700 feet. It is part of the Kicking Horse-Columbia drainage; the drainage area, as measured from a Dominion sectional map, scale 3 miles to an inch, is 90 square miles. The precipitation varies from 40 to 60 inches, of which about 40 per cent is snowfall; the winter conditions are very severe. The Ottertail is about 15 miles long, 35 feet wide, and from 2 to 5 feet deep. There are no decided falls on the stream, but a series of rapids and falls, 3 to 4 feet in height, constitutes an average drop of 40 feet to the mile. The stream is very swift, and flows over a rocky bed. The valley, generally, is very steep and narrow, and is heavily timbered.

At present there are no active interests on the stream. Logging may be successfully carried on during June, July and August, and as there is a considerable amount of good timber up the valley, this interest will doubtless be developed. There are also several mining claims, which may be worked to good advantage. The power possibilities are limited to small powers.

The river station on the Ottertail was established June 6, 1912, by C. E. Richardson. The measuring section is located 200 yards above the highway bridge (the old C.P.R. grade) between Field and Ottertail, about 1 mile from the mouth; measurements are made from a temporary foot-bridge with a meter suspended by a wading rod. A standard vertical staff gauge is fastened to the downstream side of a pile on the left bank of the stream, under the above-mentioned highway bridge; its datum is referred to three bench-marks. The section is very satisfactory; there is good control, a swift uniform current, high banks, and one channel, with a permanent rocky bed.

Discharge Measurements of Ottertail River, near Field, B.C., 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
June 6	C. E. Richardson	1048	28	62	2·2	2·72	138
June 28	"	1048	33	104	6·3	3·60	650
Aug. 12	"	1048	29	91	4·5	3·25	408

DAILY GAUGE HEIGHT AND DISCHARGE of Ottertail River near Field, for 1912.

Day.	JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	Mean.	100	2·35	475	3·45	542	3·3	442	2·75	151	2·4	58
2			3·5	577	3·35	475	3·25	410	2·75	151	2·3	42
3			3·25	410	3·25	475	3·35	475	2·75	151	2·5	77
4			3·3	442	3·4	508	3·2	379	2·8	172	2·5	77
5			3·4	508	3·4	508	3·2	379	2·75	151	2·5	77
6	2·75	151	3·35	475	3·35	475	3·25	410	2·75	151	2·5	77
7	3·15	350	3·5	577	3·25	410	3·17	362	2·75	151	2·5	77
8	3·35	475	3·45	542	3·35	475	3·2	379	2·75	151	2·5	77
9	3·3	442	3·55	614	3·35	475	3·15	350	2·75	151	2·45	68
10	3·3	442	3·5	577	3·35	475	3·17	362	2·7	130		
11	3·5	577	3·55	614	3·3	442	3·15	350	2·7	130		
12	3·5	577	3·5	577	3·25	410	3·15	350	2·7	130		
13	3·75	764	3·6	650	3·25	410	3·1	321	2·7	130		
14	3·5	577	3·55	614	3·25	410	3·05	294	2·7	130		
15	3·55	614	3·55	614	3·3	442	3·02	278	2·65	115		
16	3·55	614	3·55	614	3·25	410	3·02	278	2·7	130		
17	3·6	650	3·45	542	3·45	542	3·0	267	2·75	151		
18	3·75	764	3·4	508	3·25	410	3·02	278	2·7	130		
19	3·85	841	3·45	542	3·4	508	3·0	267	2·7	130		
20	3·9	880	3·45	542	3·4	508	2·92	228	2·65	115		
21	3·8	802	3·35	475	3·35	475	2·92	228	2·65	115		
22	3·85	841	3·4	508	3·4	508	2·9	218	2·65	115		
23	3·85	841	3·35	475	3·4	508	2·87	204	2·65	115		
24	3·75	764	3·4	508	4·0	960	2·8	172	2·6	100		
25	3·7	725	3·35	475	3·85	841	2·87	204	2·6	100		
26	3·75	764	3·35	475	3·6	650	2·82	181	2·6	100		
27	3·5	577	3·3	442	3·55	614	2·8	172	2·6	100		
28	3·65	688	3·3	442	3·5	577	2·8	172	2·5	77		
29	3·45	544	3·3	442	3·45	542	2·77	160		60		
30	3·4	508	3·35	475	3·35	475	2·75	151	2·3	42		
31			3·4	508	3·3	442			2·3	42		

MONTHLY DISCHARGE of Ottertail River, near Field, for 1912.

(Drainage area, 90 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
June	880	100	542	6·0	6·7	32,300
July	650	410	524	5·8	6·7	32,200
August	960	410	513	5·7	6·6	31,500
September	475	151	291	3·2	3·6	17,300
October	151	42	121	1·3	1·5	7,440

NOTE.—At 5 p.m. on August 24, discharge was 1,120 c.f.s. Winter conditions set in early in November. Accuracy, "B."

Paul Creek.

Paul creek has its source in township 20-14-6, at an elevation of 3,500 feet and, flowing in a westerly direction, discharges into North Thompson river, near Kamloops, at an elevation of 1,140 feet. It is part of the North Thompson drainage; the drainage area, as measured from a Geological Survey map, dated 1895, scale 2 miles to an inch, is 110 square miles; of this area, 65 square miles is above the outlet of Paul lake. The precipitation varies from 25 inches in the hills at the source, to 10 inches at the mouth. Paul creek is a contentious irrigation stream, about 20 miles in length, varying from 5 to 25 feet in width and from several inches to a foot in depth. The drainage basin of Paul creek is well timbered with British Columbia fir, and, in the upper reaches, spruce and balm of Gilead are to be found. The first record on the stream is held by the Indians of the Kamloops Indian Reserve, and it is regrettable that this somewhat large share of the supply is not used to better advantage. Often, at the height of the irrigation season, the Indians' ditch may be seen discharging into the Thompson, while their fertile land lies idle awaiting the water so necessary for successful production.

The surplus flow of the stream, after the Indians are supplied, is held by the Harper estate, 12 miles east of Kamloops, on South Thompson river. A dam has been built, with the co-operation of the Indians, on Paul lake, for storage purposes, and is effective in impounding a good portion of the spring run-off. The dam could, however, be much improved, and the whole run-off successfully stored.

In its upper reaches, Paul creek flows through several large marshes and hay meadows, which flood in the spring time. It has been suggested that if the channel of Paul creek were deepened as it passes through these meadows and marshes, that evaporation would be materially decreased, and the flow of Paul creek augmented.

The residents of upper Paul creek (east of Pinantan lake) can raise good crops in average years without the aid of irrigation, although water, when judiciously applied, is of much assistance.

Below Paul lake (235).—The station on Paul creek below Paul lake was established July 2, 1911, by C. G. Cline. The measuring section is in a flume just above the Harper Estate diversion. A standard vertical staff gauge is located on the left bank, 50 feet above the measuring section; all measurements are made by wading. This station was established to determine the flow from Paul lake.

Above Pinantan lake (234).—This station was established August 25, 1911, by C. G. Cline, but was abandoned at the end of the irrigation season of 1912. This station was unsatisfactory, as the stream overflowed its banks during high water.

Below Pinantan lake (268).—This station was established June 13, 1912, by E. M. Dann. The measuring section is located on the downstream side of the highway bridge, 100 feet below the outlet of Pinantan lake; all measurements are made by wading. A standard vertical staff gauge is located on the downstream side of the bridge. This station was established to take the place of the one abandoned (No. 234). Two measurements were taken in 1912. (*See* miscellaneous measurements on Paul creek.)

Discharge Measurements of Paul Creek, below Paul Lake, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
1911.							
July 2	C. G. Cline	1046	5·7	1·71	8·71	1·95	14·9
August 24	"	1046	3·0	1·70	0·95	1·48	1·6
October 9	"	1046	3·0	0·88	0·98	1·40	0·9
1912.							
April 15	C. G. Cline, E. M. Dann					1·2	0·0
June 3	E. M. Dann	1044	5·5	6·75	10·1	2·75	68
June 23	"	1044	5·5	5·55	7·86	2·46	43·6
August 4	H. J. E. Keys	1046	6·0	1·9	7·6	1·72	14·5

Gauge Height and Daily Discharge of Paul Creek, below Paul Lake, for 1911.

Day.	August.		September.		October.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		2·8		1·4	1·4	0·8
2		2·8	1·45	1·4		0·8
3	1·55	2·8		1·4		0·8
4		2·7		1·4		0·8
5		2·6	1·45	1·4		0·8
6		2·5		1·3	1·4	0·8
7		2·4		1·2		
8		2·4		1·1		
9	1·52	2·3	1·42	1·0		
10		2·2		1·0		
11		2·0		1·0		
12	1·5	1·9	1·42	1·0		
13		1·9		1·0		
14	1·5	1·9		0·9		
15		1·9	1·41	0·9		
16		1·9		0·9		
17		1·8		0·8		
18	1·49	1·8		0·8		
19		1·8	1·4	0·8		
20		1·7		0·8		
21		1·6		0·8		
22	1·47	1·6	1·4	0·8		
23		1·6		0·8		
24		1·5		0·8		
25		1·5	1·4	0·8		
26	1·45	1·4		0·8		
27		1·4		0·8		
28		1·4		0·8		
29	1·45	1·4	1·4	0·8		
30		1·4		0·8		
31		1·4				

Monthly Discharge of Paul Creek, below Paul Lake, for 1911.

(Drainage area, 65 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
August	2·8	1·4	1·95	0·03	0·035	120	
September	1·4	0·8	0·98	0·02	0·022	58	
Total period							12

Note.—Station was established July 2. Artificial control by storage dam on Paul lake. Accuracy "B."

Gauge Height and Daily Discharge of Paul Creek, below Paul Lake, for 1912.

Day.	May.		June.		July.		August.		September.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge height	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1				64		24		1		9·1
2				4		23		13		9·1
3			2·75	64		2		15	1·64	9·1
4				64	1·91	20		13		8·8
5				64		20		13		8·5
6				64		20		12		8·2
7				64	1·91	20		12		7·9
8				64		20		12	1·76	7·
9				64		20	1·71	12		7·6
10				64		19		12		7·6
11				6·5		19		12		7·6
12		64		6·5		19	1·71	12		7·6
13		64		6·5		18		12		7·6
14		64		35	1·86	1		12		7·6
15		64		35		1		11		7·6
16		64		35		17		11		7·6
17		64		35		16		11		7·6
18		64	2·24	35		15	1·6	10·7		7·6
19		64		34		15		10·6	1·53	7·6
20		64		3		15		10·4		7·6
21		64	2·16	31	1·76	14		10·2		7·6
22		64		30		14		10·0		7·6
23		64		30		14		9·9		7·6
24		64		9		14		9·8		7·6
25		64		28		14		9·7	1·2	0·0
26		4		27		14		9·5		
27		64		7		14		9·4		
28		64		26	1·6	14		9·3		
29		64	2·06	26		14		9·2		
30		64		25		14	1·61	9·1		
31		64				14		9·1		

MONTHLY DISCHARGE of Paul Creek, below Paul Lake, for 1912.

(Drainage area, 65 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	64	0·0	41·3	0·64	0·74	2, 40	
June	64	25	39·3	0·6	0·7	2,338	
July	24	14	17·2	0·26	0·30	1,058	
August	13	9·1	11·1	0·17	0·20	682	
September	9·1	0·0	6·3	0· 0	0·11	375	
The period							15

NOTE.—This stream is controlled by a dam at the outlet of Paul lake. The station is maintained during irrigation season only. During the late fall, the winter, and the early spring, the discharge of Paul creek is practically nil. Winter conditions exist on Paul creek during December, January and February.

Accuracy "B" and "C."

DISCHARGE MEASUREMENTS of Paul Creek, above Pinantan Lake, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
1911.							
Aug. 25	C. G. Cline	1046	3·5	1·24	0·16	1·03	0·2
1912.							
Apr. 16	E. M. Dann, C. G. Cline	1046	5·0	8·9	1·2	2·66	10·6
May 22	E. M. Dann	1044	10·0	9·7	2·2	3·60	21·8
June 11	"	1044	5·0	5·4	1·05	2·00	5·6
Aug. 12	H. J. E. Keys	1057	6·0	1·0	1·15	1·30	1·1*

*Different measuring section.

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Daily Gauge Height and Discharge of Paul Creek, above Pinantan Lake, for 1911.

Day.	August.		September.		October.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·95	0·1		0·2
2			0·95	0·1	1·0	0·2
3			1·0	0·2	1·0	0·2
4			1·0	0·3	1·0	0·2
5			1·05	0·3	1·0	0·2
6			1·0	0·2	1·0	0·2
7			1·0	0·2	1·0	0·2
8			1·0	0·2	1·0	0·2
9			1·0	0·2	1·0	0·2
10			1·0	0·2	1·0	0·2
11			1·0	0·	1·0	0·2
12			1·0	0·2	1·0	0·2
13			1·05	0·3	1·0	0·2
14			1·05	0·3	1·0	0·2
15			1·0	0·2	1·0	0·2
16			1·0	0·2	1·0	0·2
17			1·0	0·	1·0	0·2
18			1·0	0·	1·0	0·2
19			1·0	0·2	1·0	0·2
20			1·0	0·2	1·0	0·2
21			1·0	0·2	1·0	0·2
22			1·0	0·2	1·0	0·2
23			1·0	0·2	1·0	0·2
24				0·2	1·0	0·2
25	1·0	0·2	1·0	0·2	1·0	0·2
26	1·0	0·2	1·0	0·2	1·0	0·2
27	1·0	0·2	1·0	0·2		
28	1·0	0·2	1·0	0·2		
29	1·05	0·2	1·0	0·2		
30	1·05	0·3	1·0	0·2		
31	1·0	0·2				

Monthly Discharge of Paul Creek, above Pinantan Lake, for 1911.

(Drainage area, 15 square miles.)

Month.	Discharge in Second Feet.			Run-Off.		Rainfall.
	Maximum	Minimum	Mean	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
September	0·3	0·1	0·2	0·01	0·011	12	
October	0·2	0·2	0·2	0·01	0·012	12	
The period							12

Note.—Station was established August 25, and maintained until freeze-up, which occurred October 26. Accuracy, "B."

DAILY GAUGE HEIGHT AND DISCHARGE of Paul Creek, above Pinantan Lake, for 1912.

Day.	April.		May.		June.		July.		August.		September.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	2·8	11·5	3·7	.....	3·0	13·5	1·8	3·9	1·3	1·1	1·3	1·1
2	2·8	11·5	3·7		2·8	11·5	1·8	3·9	1·3	1·1	1·4	1·6
3	2·9	12·5	3·7		2·7	10·7	1·8	3·9	1·3	1·1	1·4	1·6
4	3·1	14·6	3·7		2·6	9·9	1·8	3·9		1·1	1·3	1·1
5	3·1	14·6	3·7		2·5	9·1	1·9	4·6	1·3	1·1	1·3	1·1
6	3·3	17·1	3·8		2·4	8·3	1·9	4·6	1·3	1·1	1·2	1·1
7	3·5	20·2	3·8		2·4	8·3		4·6	1·2	0·7	1·4	1·6
8	3·8		3·8		2·3	7·5	1·9	4·6	1·2	0·7	1·4	1·6
9	3·5	20·2	3·8		2·2	6·7	1·9	4·6	1·4	1·6		1·4
10	2·8	11·5	3·8		2·1	6·0	1·8	3·9	1·3	1·1	1·3	1·1
11	2·7	10·7	3·8	.....	2·0	5·3	1·8	3·9		1·1		1·1
12	2·6	9·9	3·8		2·0	5·3	1·8	3·9	1·3	1·1	1·3	1·1
13	2·7	10·7	3·8		2·0	5·3	1·7	3·3	1·3	1·1	1·2	0·7
14	2·4	8·3	3·7		2·0	5·3	1·7	3·3	1·3	1·1	1·2	0·7
15	2·7	10·7	3·7		2·3	7·5	1·6	2·7	1·25	0·9	1·3	1·1
16	2·7	10·7	3·7		2·4	8·3		2·4	1·3	1·1	1·2	0·7
17		10·7	3·7		2·3	7·5	1·5	2·1	1·3	1·1		0·7
18	2·7	10·7	3·7		2·3	7·5	1·5	2·1	1·3	1·3		0·7
19	2·5	9·1	3·6	21·8	2·2	6·7	1·5	2·1	1·3	1·1		0·7
20	2·7	10·7	3·6	21·8	2·1	6·0	1·4	1·6	1·3	1·1	1·2	0·7
21	2·5	9·1	3·6	21·8	2·0	5·3		1·8	1·2	0·7	1·2	0·7
22	2·7	10·7	3·6	21·8	1·9	4·6	1·5	2·1	1·2	0·7	1·2	0·7
23	3·05	14·0	3·6	21·8	1·8	3·9	1·5	2·1	1·2	0·7	1·2	0·7
24	3·5	20·2	3·6	21·8	1·8	3·9	1·6	2·7	1·2	0·7	1·2	0·7
25	3·6	21·8	3·6	21·8	1·8	3·9	1·6	2·7		0·9	1·2	0·7
26	5·6	21·8	3·5	20·2		3·9	1·6	2·7	1·3	1·1	1·2	0·7
27	3·6	21·8	3·5	20·2	1·8	3·9	1·5	2·1	1·3	1·1	1·2	0·7
28	3·7		3·4	18·6	1·8	3·9	1·5	2·1	1·2	0·7		
29	3·7		3·3	17·1	1·8	3·9	1·5	2·1	1·2	0·7		
30	3·7		3·3	17·1	1·8	3·9	1·5	2·1	1·3	1·1		
31			3·2	15·8			1·4	1·6	1·4	1·6		

MONTHLY DISCHARGE of Paul Creek, above Pinantan Lake, for 1912.
(Drainage area, 15 square miles.)

Month.	Discharge in Second-Feet.			Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April		9·1					
May		15·8					
June	13·5	3·9	6·6	0·44	0·49	393	
July	4·6	1·6	3·0	0·20	0·23	184	
August	1·6	0·7	1·0	0·07	0·08	61	
September	1·6	0·7	1·0	0·07	0·08	60	
The period							15

NOTE.—During May a large fire-bet occurred and Paul creek at this gauging section overflowed its banks and flooded the meadow through which it runs. Hence the data for May are incomplete; a conservative estimate of the mean flow during this month is about 30 second-feet. A station has been established below Pinantan lake at a point where the stream is better confined, and, for the future, this station is the one to be used.

Accuracy, "B."

Pemberton Creek (218.)

Pemberton creek has its source in the mountains west of Niskonlith lake, at an elevation of 2,200 feet, and discharges into South Thompson river from the north, near Pritchard, at an elevation of 1,140 feet. It is part of the South Thompson drainage area, as measured from a Geological Survey map, dated 1895, scale 2 miles to an inch, is 8 square miles. The precipitation would average 12 inches, seldom, if ever, reaching 18 inches; the summers are hot and dry, the winters long and severe (–20° F.). Pemberton creek is a very small stream, its maximum flow being only 10 second-feet. It is about 4 miles long, 2 to 6 feet in width, and is never much more than a foot deep. The creek flows, for the most part, through a hilly, arid country, similar to that seen in the Ashcroft district. The total flow of Pemberton creek is insufficient to supply the needs of the Pemberton Estate, which holds the only records on the creek. In days gone by, water was diverted into Pemberton creek from the lakes at the head of Paul creek, for the use of the estate, but even thus augmented, the flow of Pemberton creek was small.

The fifteen hundred acres of land on the Pemberton Estate have lain idle for several years owing to the litigation in progress with regard to its disposal. The diversion of water from Niskonlith lake, and pumping on the lower benches are two methods by which this excellent land might be reclaimed. If one of these schemes were adopted, the water of Pemberton creek could be used to great advantage by local homesteaders. The station on Pemberton creek was established August 26, 1911, by C. G. Cline. The measuring section is located opposite the Warren house, 2 miles from the mouth; a standard vertical staff gauge is driven into the right bank at the section, and its datum referred to two bench-marks. In low water, measurements are made by floats; in high water, by wading. The section is satisfactory; the control is good, banks not liable to overflow, current uniform, and one channel with a permanent sandy bed.

Discharge Measurements of Pemberton Creek, two miles from mouth, 1911.

Date	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.
1911			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
August 26	C. G. Cline					1.00	0.01
1912							
April 16	C. G. Cline, E. M. Dann.		2.0	1.0	0.8	1.07	0.25
May 20	E. M. Dann.					1.40	2.1

[1] Measured by noting time required to fill a receptacle of known capacity.
[2] Float measurement.

DAILY GAUGE HEIGHT AND DISCHARGE of Pemberton Creek, two miles from mouth, for 1911.

Day.	September.		October.	
	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·0	0·05
2			1·0	0·05
3			1·0	0·05
4			1·05	0·3
5			1·05	0·3
6			1·05	0·3
7			1·05	0·3
8			1·05	0·3
9			1·05	0·3
10			1·05	0·3
11			1·05	0·3
12			1·05	0·3
13			1·05	0·3
14			1·05	0·3
15			1·05	0·3
16			1·05	0·3
17			1·05	0·3
18			1·05	0·3
19			1·1	0·6
20			1·1	0·6
21			1·1	0·6
22	1·02	0·16	1·1	0·6
23	1·02	0·16	1·1	0·6
24	1·02	0·16	1·1	0·6
25	1·02	0·16	1·1	0·6
26	1·02	0·16	1·1	0·6
27	1·02	0·16	1·1	0·6
28	1·02	0·16	1·1	0·6
29	1·0	0·05	1·1	0·6
30	1·0	0·05	1·1	0·6
31			1·1	0·6

MONTHLY DISCHARGE of Pemberton Creek, two miles from mouth, for 1911.

(Drainage area, 8 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
October	0·6	0·05	0·4	0·05	0·06	25	
The period							10

NOTE.—Station was established August 26, 1911.
Accuracy, "A."

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DAILY GAUGE HEIGHT AND DISCHARGE of Pemberton Creek, two miles from mouth, for 1912.

Day.	April.		May.		June.		July.		August.		September.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·5	8·9		1·1	1·05	0·3	0·95	0·02	1·0	0·05
2			1·5	8·9	1·15	1·1	1·05	0·3	0·95	0·02	1·0	0·05
3				8·5	1·1	0·6	1·0	0·05	0·95	0·02	1·0	0·05
4				8·0	1·1	0·06	1·0	0·05	0·95	0·02	0·95	0·02
5			1·45	7·5	1·1	0·6	1·05	0·3	0·9	0·0	0·95	0·02
6			1·45	7·5	1·05	0·3	1·0	0·05	0·95	0·02	0·95	0·02
7	1·1	0·6	1·4	6·0		0·3	1·05	0·3	0·95	0·02	1·0	0·05
8	1·1	0·6	1·4	6·0		0·3	1·05	0·3	0·95	0·02	1·05	0·3
9	1·1	0·6	1·35	4·8	1·05	0·3	1·05	0·3	0·95	0·02	1·05	0·3
10	1·1	0·6	1·35	4·8	1·05	0·3	1·0	0·05	0·95	0·02	1·0	0·05
11	1·1	0·6		4·2	1·0	0·05	1·05	0·3	0·95	0·02	1·0	0·05
12	1·1	0·6	1·3	3·6	1·0	0·05	1·25	2·6	0·95	0·02	1·0	0·05
13	1·1	0·6	1·3	3·6	1·0	0·05	1·2	1·7	0·95	0·02	1·0	0·05
14	1·1	0·6	1·3	3·6		0·05	1·2	1·7	0·95	0·02	1·0	0·05
15	1·1	0·6	1·25	2·6		0·05	1·15	1·1	0·95	0·02	1·0	0·05
16	1·1	0·6	1·25	2·6	1·0	0·05	1·15	1·1	1·0	0·05	1·0	0·05
17	1·15	1·1		2·3	1·1	0·6	1·15	1·1	1·0	0·05		
18	1·2	1·7		2·0	1·05	0·3	1·1	0·6	1·0	0·05		
19		2·0	1·2	1·7	1·05	0·3	1·0	0·05	0·95	0·02		
20		2·3	1·2	1·7	1·05	0·3	1·05	0·3	0·95	0·02		
21	1·25	2·6	1·2	1·7	1·0	0·05	1·05	0·3	0·95	0·02		
22	1·25	2·6	1·2	1·7	1·0	0·05	1·05	0·3	0·95	0·02		
23	1·3	3·6	1·2	1·7	1·05	0·3	1·1	0·6	0·95	0·02		
24	1·35	4·8		1·6	1·0	0·05	1·05	0·3	0·95	0·02		
25	1·3	3·6		1·4	1·0	0·05	1·05	0·3	1·0	0·05		
26	1·3	3·6	1·15	1·1	1·0	0·05	1·05	0·3	1·0	0·05		
27	1·3	3·6	1·15	1·1	1·05	0·3	1·05	0·3	0·95	0·02		
28	1·4	6·0	1·15	1·1	1·05	0·3	1·0	0·05	1·0	0·05		
29	1·45	7·5	1·15	1·1	1·0	0·05	1·0	0·05	1·0	0·05		
30	1·5	8·9	1·15	1·1	1·05	0·3	1·0	0·05	1·0	0·05		
31				1·1			0·95	0·02	1·0	0·05		

MONTHLY DISCHARGE of Pemberton Creek, two miles from mouth, for 1912.

(Drainage area, 8 square miles.)

Month.	Discharge in Second-Feet.				Run Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	8·9	0·6	2·5	0·31	0·35	149	
May	8·9	1·1	3·7	0·46	0·53	227	
June	1·1	0·05	0·29	0·04	0·04	17	
July	2·6	0·02	0·49	0·06	0·07	30	
August	0·05	0·0	0·03	0·004	0·005	2	
The period							12

Accuracy, "B."

Pendleton Creek (227).

Pendleton creek has its source in the hills south of Kamloops lake, at an elevation of 3,800 feet, and discharges into Cherry creek at Kensington ranch, at an elevation of 2,000 feet. It is part of the Cherry-Thompson drainage; the drainage area, as measured from the Dominion sectional map, dated May 15, 1907, scale 3 miles to an inch, is 4 square miles. Pendleton creek is a small irrigation stream in the heart of the Dry Belt; the summers are hot and dry, the winters long and cold (–30° F.); the mean annual precipitation is about 10 inches.

The stream is not very important, running only for a few weeks in the spring; in very dry years there is no flow. About 2 miles from the mouth, the freshet water is stored in a small meadow, 10 acres in extent, by a dam about 100 feet long, and 4 feet high.

A station was established on Pendleton creek April 23, 1912, by H. J. E. Keys. The measuring section is located about 200 yards above the dam and 175 yards below the cattle crossing. A standard vertical staff gauge is located 50 yards below the cattle crossing. The measuring section is fair, there being one permanent channel, and a uniform current; but the banks, in very high water, are liable to overflow. The datum of the gauge is referred to three bench-marks.

Discharge Measurements of Pendleton Creek, near Cornwall's ranch, 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1912.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
April 23	H. J. E. Keys	1057	4	1·3	0·3	1·15	0·4
May 18	"	1057	4	3·1	1·3	1·35	3·9
May 28	"	1057	3·5	1·3	0·9	1·22	1·1
June 26	"					1·00	0·0

GAUGE HEIGHTS AND DAILY DISCHARGE of Pendleton Creek, near Cornwall's ranch, for 1912.

DAY.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1....			1·3	2·6	1·2	0·8	1·0	0·0	1·0	0·0		
2....				3·0		0·8		0·02		0·0	0·85	0·0
3....				3·4		0·8		0·05	1·0	0·0	1·0	0·0
4....				3·8	1·2	0·8	1·05	0·08	1·0	0·0		0·04
5....				4·2		0·7	1·25	1·7		0·0		0·08
6....				4·6		0·6		1·7		0·0		0·12
7....				5·0	1·15	0·48		1·7	1·0	0·0	1·1	0·15
8....				5·4		0·37	1·25	1·7		0·0		0·11
9....				5·9		0·26		1·7	1·0	0·0	1·05	0·08
10....				6·4	1·1	0·15	1·25	1·7		0·0		0·04
11....			1·45	6·9		0·15		1·3	1·0	0·0	1·0	0·0
12....				7·7	1·1	0·15		0·9		0·0		0·0
13....			1·5	8·5		0·26	1·15	0·47		0·0	1·0	0·0
14....				6·9		0·26		0·27	0·2	0·0		
15....			1·4	5·3	1·15	0·48	1·05	0·08		0·0		
16....				5·0		0·28		0·04	0·25	0·0		
17....				4·7	1·05	0·08	1·0	0·0		0·0		
18....				4·4		0·08		0·0		0·0		
19....			1·35	4·0	1·05	0·08	1·0	0·0	0·3	0·0		
20....			1·5	4·0		0·05		0·05		0·0		
21....				3·8		0·02		0·10		0·0		
22....			1·3	2·6	1·0	0·0	1·1	0·15	0·3	0·0		
23....				1·7		0·0		0·15		0·0		
24....			1·2	0·8		0·0		0·15	0·25	0·0		
25....				0·8		0·0	1·1	0·15		0·0		
26....			1·2	0·8	1·0	0·0		0·11	0·25	0·0		
27....				0·8		0·0	1·05	0·07		0·0		
28....	1·2	0·8	1·2	0·8	1·0	0·0		0·07	0·25	0·0		
29....		1·2		0·8		0·0	1·05	0·07		0·0		
30....		1·6		0·8	1·0	0·0		0·05		0·0		
31....		2·1	1·2	0·8		0·0		0·03	0·25	0·0		

MONTHLY DISCHARGE of Pendleton Creek, near Cornwall's ranch, for 1912.

(Drainage area, 4 square miles.)

Month.	DISCHARGE IN SECOND FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	8·5	0·8	3·7	0·9	1·04	227	
June	0·5	0·0	0·26	0·06	0·07	15	
July	6·0	1·7	0·5	0·12	0·14	29	
The period							12

Accuracy, "B."

Peterson Creek (274).

Peterson creek has its source in Jacko lake, 10 miles south of Kamloops, at an elevation of 2,200 feet and discharges into the South Thompson at Kamloops, at an elevation of 1,140 feet. It is part of the Thompson drainage; the drainage area, as measured from the Geological Survey map, dated 1895, scale 2 miles to an inch, is 55 square miles. This is a very contentious irrigation stream, situated in the most arid section of the Dry Belt. The summers are very hot and dry, the winters long and cold (–30 F.) The annual precipitation is approximately 10 to 12 inches.

Peterson creek is a good example of an over-recorded irrigation stream. There are records for over 1,500 inches extant. During 1912 (a very wet season), Jacko lake was so low that the water did not reach the level of the ditch intakes. Four miles below Jacko lake, Peterson creek did not attain a discharge greater than 1 second-foot and only ran for 10 days. Above the city of Kamloops there are several small springs in the creek, which are used for irrigation purposes. In the city itself the stream only runs spasmodically during the spring. There is no regular station on Peterson creek, but four miscellaneous measurements were taken during 1912. In the spring of that year the freshet was very large, running 80 second-feet, and did considerable damage to property in the city.

The city of Kamloops has under consideration the construction of a concrete conduit for carrying the flood waters of Peterson creek through the city. (*See* miscellaneous measurements on Peterson creek and on Jacko creek, which is the upper part of Peterson creek.)

Pollard Creek (116).

Pollard creek has its source in the hills northeast of Coquitlam, at an elevation of 2,000 feet, and discharges into Pitt river near Coquitlam, at an elevation of 10 feet. It is part of the Pitt-Fraser drainage; the estimated drainage area above the station is 3 square miles. The annual precipitation, including from 1 to 2 feet of snow, is 60 inches; the winter conditions are mild, the stream being open the entire year. The creek is of little value, except as a possible water supply for the town of Coquitlam.

The station was established November 20, 1911, by K. H. Smith. It is located about 300 yards east of the Pollard house, 5 miles out of Coquitlam. A staff gauge is situated on the left bank, and its datum is referred to three bench-marks. The measuring section is at the gauge, and is well located; there is only one permanent channel, good banks (liable to overflow slightly in high water), good control and a uniform current. All measurements are made by wading.

Discharge Measurements of Pollard Creek, at mouth, 1911.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Nov. 20	K. H. Smith	1057	5·0	4·6	1·	1·7	7·8
Dec. 23	"	1057	4·5	2·8	1·6	1·5	4·6

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Daily Gauge Height and Discharge of Pollard Creek, near mouth, for 1911.

Day.	November.		December.	
	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·3	2·7
2			1·3	2·7
3			1·2	2·0
4			1·2	2·0
5			1·3	2·7
6			1·4	3·6
7			1·4	3·6
8			1·5	4·4
9			1·6	6·1
10			1·5	4·7
11			1·6	6·1
12			1·4	3·6
13			1·3	2·7
14			1·2	2·0
15			1·4	3·6
16			1·3	2·7
17			1·2	2·0
18			1·3	2·7
19			1·4	3·6
20	1·7	7·7	1·3	2·7
21	1·5	4·7	1·3	2·7
22	1·4	3·6	1·6	6·1
23	1·3	2·7	1·5	4·7
24	1·2	2·0	1·4	3·6
25	1·6	6·1	1·3	2·7
26	1·4	3·6	1·2	2·0
27	1·3	2·7	1·4	3·6
28	1·3	2·7	1·3	2·7
29	1·2	2·0	1·2	2·0
30	1·3	2·7	1·1	1·5
31			1·1	1·5

Monthly Discharge of Pollard Creek, near mouth, for 1911.

(Drainage area, 3 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches
November	7·7	2·0					
December	9·4	1·5	3·4	1·1	1·3	209	
The period							60

Accuracy, "B."

DAILY GAUGE HEIGHT AND DISCHARGE

Day.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft
1....	1·1	1·5	1·3	2·7	0·9	0·7	0·5	0·1	1·0	1·0	0·7	0·3
2....	1·0	1·0	1·2	2·0	0·9	0·7	0·6	0·2	1·1	1·5	0·7	0·3
3....	1·0	1·0	1·1	1·5	0·9	0·7	0·7	0·3	1·1	1·5	0·6	0·2
4....	0·9	0·7	1·1	1·5	0·8	0·4	0·8	0·4	1·0	1·0	0·6	0·2
5....	0·9	0·7	1·0	1·0	0·8	0·4	0·7	0·3	1·0	1·0	0·6	0·2
6....	1·0	1·0	1·0	1·0	0·8	0·4	0·6	0·2	1·0	1·0	0·6	0·2
7....	0·9	0·7	1·0	1·0	0·8	0·4	0·6	0·2	0·9	0·7	0·6	0·2
8....	0·8	0·4	1·1	1·5	0·7	0·3	0·6	0·2	0·9	0·7	0·5	0·1
9....	0·9	0·7	1·4	3·6	0·7	0·3	0·8	0·4	0·8	0·4	0·5	0·1
10....	1·1	1·5	1·4	3·6	0·7	0·3	1·1	1·5	0·8	0·4	0·5	0·1
11....	1·4	3·6	1·4	3·6	0·7	0·3	1·0	1·0	0·7	0·3	0·7	0·3
12....	1·7	7·7	1·4	3·6	0·7	0·3	0·9	0·7	0·6	0·2	1·0	1·0
13....	1·8	9·4	1·4	3·6	0·7	0·3	0·9	0·7	0·6	0·2	1·0	1·0
14....	1·8	9·4	1·5	4·7	0·8	0·4	0·9	0·7	0·6	0·2	1·0	1·0
15....	1·6	6·1	1·7	7·7	0·8	0·4	0·9	0·7	0·6	0·2	1·0	1·0
16....	1·5	4·7	1·6	6·1	0·8	0·4	0·8	0·4	0·6	0·2	0·9	0·7
17....	1·3	2·7	1·5	4·7	0·8	0·4	0·9	0·7	0·6	0·2	0·8	0·4
18....	1·3	2·7	1·4	3·6	0·7	0·3	1·0	1·0	0·6	0·2	0·8	0·4
19....	1·2	2·0	1·3	2·7	0·7	0·3	0·9	0·7	0·7	0·3	0·7	0·3
20....	1·4	3·6	1·2	2·0	0·7	0·3	0·9	0·7	0·9	0·7	0·8	0·4
21....	1·3	2·7	1·1	1·5	0·7	0·3	0·9	0·7	1·2	2·0	1·1	1·5
22....	1·2	2·0	1·3	2·7	0·7	0·3	0·9	0·7	1·2	2·0	1·1	1·5
23....	1·2	2·0	1·2	2·0	0·7	0·3	1·0	1·0	1·3	2·7	1·0	1·0
24....	1·4	3·6	1·1	1·5	0·6	0·2	0·9	0·7	1·1	1·5	1·0	1·0
25....	1·3	2·7	1·1	1·5	0·6	0·2	0·8	0·4	1·1	1·5	0·9	0·7
26....	1·4	3·6	1·1	1·5	0·6	0·2	0·8	0·4	1·0	1·0	0·8	0·4
27....	1·3	2·7	1·0	1·0	0·6	0·2	0·9	0·7	0·9	0·7	0·7	0·3
28....	1·5	4·7	1·0	1·0	0·6	0·2	1·0	1·0	0·8	0·4	0·7	0·3
29....	1·7	7·7	1·0	1·0	0·6	0·2	1·2	2·0	0·8	0·4	0·7	0·3
30....	1·5	4·7	.....	.....	0·6	0·2	1·2	2·0	0·8	0·4	0·7	0·3
31....	1·4	3·6	.....	.....	0·6	0·2	.....	.....	0·8	0·4	.....	.....

of Pollard Creek, near mouth, for 1912.

July.		August.		September.		October.		November.		December.		
Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Day.
Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	
0·7	0·3	0·6	0·2	1·5	4·7	0·6	0·2	1·1	1·5	1·4	3·6	1
0·7	0·3	0·6	0·2	1·7	7·7	0·7	0·3	1·1	1·5	1·5	4·7	2
0·7	0·3	0·6	0·2	1·6	6·1	0·8	0·4	1·2	2·0	2·1	14·6	3
0·8	0·4	0·5	0·1	1·4	3·6	0·7	0·3	1·4	3·6	2·0	12·9	4
0·9	0·7	0·5	0·1	1·2	2·0	0·7	0·3	1·5	4·7	1·8	9·4	5
0·9	0·7	0·5	0·1	1·2	2·0	0·7	0·3	1·5	4·7	1·7	7·7	6
0·9	0·7	0·5	0·1	1·2	2·0	0·6	0·2	1·5	4·7	1·6	6·1	7
0·8	0·4	0·7	0·3	1·0	1·0	0·7	0·3	1·4	3·6	1·6	6·1	8
0·7	0·3	0·6	0·2	0·9	0·1	0·7	0·3	1·3	2·7	1·8	9·4	9
0·7	0·3	0·7	0·3	0·8	0·4	0·7	0·3	1·5	4·7	1·7	7·7	10
0·7	0·3	0·6	0·2	0·8	0·4	0·7	0·3	1·6	6·1	1·6	6·1	11
0·7	0·3	0·6	0·2	0·8	0·4	0·7	0·3	1·7	7·7	1·5	4·7	12
0·7	0·3	0·6	0·2	0·7	0·3	0·7	0·3	1·7	7·7	1·4	3·6	13
0·6	0·2	0·6	0·2	0·7	0·3	0·7	0·3	1·5	4·7	1·3	2·7	14
0·6	0·2	1·4	3·6	0·7	0·3	1·1	1·5	1·3	2·7	1·3	2·7	15
0·6	0·2	1·7	7·7	0·6	0·2	1·3	2·7	1·2	2·0	1·6	6·1	16
0·6	0·2	1·3	2·7	0·6	0·2	1·4	3·6	1·2	2·0	1·5	4·7	17
0·5	0·1	1·2	2·0	0·6	0·2	1·3	2·7	1·3	2·7	1·3	2·7	18
0·5	0·1	1·1	1·5	0·6	0·2	1·3	2·7	1·4	3·6	1·3	2·7	19
0·5	0·1	1·0	1·0	0·6	0·2	1·3	2·7	1·5	4·7	1·3	2·7	20
0·5	0·1	0·9	0·7	0·6	0·2	1·3	2·7	2·3	20·0	1·3	2·7	21
0·5	0·1	0·8	0·4	0·5	0·1	1·3	2·7	1·8	9·4	1·3	2·7	22
0·6	0·2	0·7	0·3	0·5	0·1	1·3	2·7	1·6	6·1	1·3	2·7	23
0·7	0·3	0·7	0·3	0·5	0·1	1·2	2·0	1·5	4·7	1·3	2·7	24
0·7	0·3	0·7	0·3	0·5	0·1	1·2	2·0	1·4	3·6	1·4	3·6	25
0·7	0·3	0·7	0·3	0·5	1·1	1·2	2·0	1·3	2·7	1·4	3·6	26
0·6	0·2	0·7	0·3	0·5	0·1	1·1	1·5	1·2	2·0	1·5	4·7	27
0·6	0·2	0·9	0·7	0·5	0·1	1·1	1·5	1·2	2·0	1·5	4·7	28
0·6	0·2	1·1	1·5	0·5	0·1	1·2	2·0	1·3	2·7	1·6	6·1	29
0·5	0·1	1·3	2·7	0·6	0·2	1·1	1·5	1·3	2·7	1·5	4·7	30
0·5	0·1	1·3	2·7			1·1	1·5			1·5	4·7	31

MONTHLY DISCHARGE of Pollard Creek, near mouth, for 1912.

(Drainage area, 3 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
January	9·4	0·4	3·3	1·1	1·3	203	
February	7·7	1·0	2·6	0·9	1·0	150	
March	0·7	0·2	0·3	0·1	0·1	18	
April	2·0	0·1	0·7	0·23	0·26	42	
May	2·7	0·2	0·8	0·27	0·31	49	
June	1·5	0·1	0·5	0·17	0·19	30	
July	0·7	0·1	0·3	0·1	0·11	18	
August	7·7	0·1	1·0	0·33	0·38	61	
September	7·7	0·1	1·1	0·37	0·41	65	
October	3·6	0·2	1·4	0·47	0·54	86	
November	20·0	1·5	4·4	1·5	1·7	262	
December	14·6	2·7	5·3	1·8	2·1	326	
The year	20·0	0·1	1·8	0·6	8·4	1,310	60

Accuracy "B."

QUENVILLE CREEK (270).

Quenville creek has its source in the hills east of the Guichon valley, at an elevation of 4,000 feet, and discharges into Guichon creek, a mile above Mamit lake, at an elevation of 3,300 feet. It is part of the Guichon-Nicola-Thompson drainage; the drainage area, as measured from the Geological Survey map, dated 1895, scale 2 miles to an inch, is 7 square miles. This is an irrigation stream situated in the Dry Belt; the summers are hot and dry, the winters long and cold (−40 F.); the mean annual precipitation is between 12 and 15 inches.

Quenville creek is not of much importance: There is a small lake which is used as a storage reservoir for the spring freshet. As a rule the stream runs dry in June and July. *See* miscellaneous measurements on Quenville creek. (Outside the Railway Belt.)

RAINBOW CREEK (114).

Rainbow creek has its source in the mountains on the east side of Pitt lake, outside the Railway Belt, at an elevation of 2,000 feet, and discharges into Pitt lake at an elevation of 10 feet. It is part of the Pitt-Fraser drainage. The drainage area is estimated at 20 square miles, and the annual precipitation about 70 inches. The watershed of Rainbow creek is comparatively high, rocky and wooded, with snow most of the year in the higher altitudes.

It would be possible to develop power on Rainbow creek, there being a 630-foot fall in half a mile near the mouth. There is said to be a lake near the head-waters, which might be utilized as a storage reservoir. There is a small flat at the mouth.

The station on Rainbow creek was established on November 11, 1911, by C. G. Cline. It is about 2 miles above Fader's brickyard on the east side of Pitt lake. The gauge is a vertical staff, 7 feet long, and is fastened to a stump, 100 feet below the

high fall, and 300 yards from the mouth of the creek. The datum of the gauge is referred to three bench-marks. Measurements are made by wading, except at high water, when boat measurements are made.

DISCHARGE MEASUREMENTS of Rainbow Creek, at mouth, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Nov. 11	Cline & Smith.	1053	38	64	0·7	0·82	46
Dec. 28	K. H. Smith.	1057	36	45	1·2	0·85	51
1912.							
Aug. 7	C. G. Cline.	1046	33	45	0·7	0·64	32
Nov. 2	"	1046	36	75	1·0	1·05	75

GAUGE HEIGHT AND DISCHARGE of Rainbow Creek, at mouth, for 1912.

Day.	August.		November.		December.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		33		75	0·95	61
2		33	1·05	75		62
3		33		82		63
4		33		88		64
5		33		94		65
6		33		100		66
7	0·64	33		106		67
8		31		112	1·0	68
9	0·6	30		117		75
10		90	1·4	122		82
11		150		116		89
12		210		109		96
13	2·5	270		102		103
14		200	1·2	95		110
15		130		82	1·35	116
16	0·9	55		68		113
17		55	0·9	55		110
18		55		50		107
19	0·9	55		45		104
20		52		40		101
21		49	0·7	37		98
22	0·8	45		36	1·2	95
23		50		35		100
24	0·9	55	0·65	34		105
25		55		38		110
26		55		42		115
27		55		46		120
28		55		50		125
29		55		54	1·45	129
30		55		58		129
31		55				129

MONTHLY DISCHARGE of Rainbow Creek, at mouth, for 1912.
(Drainage area, 20 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
August	270	30	71	3·5	4·0	4,370	
November	122	34	72	3·6	4·0	4,280	
December	129	61	97	4·8	5·5	5,960	
The period							70

ROBBINS CREEK (264).

Robbins creek has its source in the hills in township 19-15-6, at an elevation of 3,500 feet and, flowing in a northerly direction, discharges into Monte creek a mile and a quarter from the mouth, at an elevation of 1,500 feet. It is part of the Monte-South Thompson drainage; the drainage area, as measured from a Geological Survey map, dated 1895, scale 2 miles to an inch, is 15 square miles. The mean annual precipitation is about 10 inches; the winters are severe (−40° F.) with a small snowfall; the summers are very hot and dry.

Robbins creek is about 6 miles long, flowing into Monte creek from the west, about one and a quarter mile above the mouth. It is about 4 feet wide and 1 foot deep, with a mean velocity of from 0·2 to 4 feet per second. The creek flows through an agricultural district in the Dry Belt, and is a very contentious irrigation stream. It is recorded several times over, and, especially in dry seasons, considerable trouble arises, due to the scarcity of water. The maximum flow occurred on May 9, 1912, and was 9 c.f.s. The stream was practically dry in August; the mean flow during the irrigation season was about 1·5 c.f.s., which does not include the water that is diverted above the gauging station, and conducted into the Buce Lake storage reservoir.

The station on Robbins creek was established May 26, 1911, by C. E. Richardson. The measuring section is located below Albert Duck's diversion. A vertical staff gauge is located on the right bank below the meadows and opposite Albert Duck's house; the datum of the gauge is referred to three bench-marks. All measurements are made by wading.

DISCHARGE MEASUREMENTS of Robbins Creek, near Albert Duck's, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.
May 26	C. E. Richardson	1048	7·5	2·8	1·1	1·43	3·1
May 26	W. M. Carlyle	1044	8·0	4·6	0·7	1·43	3·1
June 4	C. E. Richardson	1048	7·0	3·6	0·5	1·38	1·6
June 15	W. M. Carlyle	1044	8·0	5·4	1·0	1·52	5·1
July 10	"	1044	6·5	3·0	0·3	1·36	1·0
" 13	"	1044	4·0	0·8	0·5	1·27	0·4
" 24	"	1044	1·7	0·4	0·3	1·18	0·1
1912.							
May 8	C. E. Richardson	1048	10·0	7·1	1·0	1·65	6·8
July 15	"	1048	2·0	0·6	0·7	1·30	0·4

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DAILY GAUGE HEIGHT AND DISCHARGE of Robbins Creek, near Albert Duck's, for 1911.

Day.	May.		June.		July.		August.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·35	1·1	1·30	0·6	1·10	0·1
2			1·38	1·6	1·30	0·6	1·08	0·0
3			1·38	1·6	1·29	0·6	1·08	0·0
4			1·38	1·6	1·28	0·5	1·09	0·1
5			1·38	1·6	1·28	0·5	1·08	0·0
6			1·40	2·0	1·26	0·4	1·11	0·1
7			1·36	1·2	1·28	0·5	1·18	0·1
8			1·35	1·1	1·30	0·6	1·14	0·1
9			1·38	1·6	1·30	0·6	1·10	0·1
10			1·39	2·0	1·31	0·7	1·10	0·1
11			1·42	2·6	1·30	0·6	1·10	0·1
12			1·42	2·6	1·29	0·6	1·09	0·1
13			1·41	2·3	1·28	0·5	1·08	0·0
14			1·45	3·3	1·26	0·4	1·08	0·0
15			1·52	5·2	1·25	0·4	1·06	0·0
16			1·50	4·7	1·25	0·4	1·02	0·0
17			1·49	4·4	1·22	0·2	Creek dry.	
18			1·46	3·6	1·22	0·2		
19			1·42	2·6	1·20	0·2		
20			1·41	2·3	1·20	0·2		
21			1·40	2·0	1·20	0·2		
22			1·42	2·3	1·19	0·2		
23			1·40	2·0	1·16	0·1		
24			1·38	1·6	1·15	0·1		
25			1·36	1·2	1·12	0·1		
26	1·31	2·3	1·32	0·8	1·11	0·1		
27	1·30	2·0	1·32	0·8	1·11	0·1		
28	1·41	2·3	1·32	0·8	1·10	0·1		
29	1·41	2·3	1·30	0·6	1·10	0·1		
30	1·40	2·0	1·30	0·6	1·10	0·1		
31	1·39	1·8			1·10	0·1		

MONTHLY DISCHARGE of Robbins Creek, near Albert Duck's, for 1911.

(Drainage area, 15 square miles.)

Month.	Discharge in Second Feet.			Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	5·2	0·6	2·1	·14	·16	125	
July	0·7	0·1	·3	·02	·02	21	
August	0·1	0·0	·005	·002	·002	2	
The period							1·9

NOTE.—This station was established after the spring freshet had occurred, so there is no record of the flow of this creek during April and May of 1911. The total run-off for these two months, however, would not have been more than 300 acre-feet. Robbins creek went dry about the middle of August, in 1911. These measurements do not include the water that is diverted above the gauging station, and conducted to the storage reservoir at Bucc lake.

Accuracy, "B."

DAILY GAUGE HEIGHT AND DISCHARGE of Robbins Creek, near Albert Duck's, for 1912.

Day.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	[illegible]	0·4	1·48	2·8	1·47	2·6	1·37	1·1	1·25	0·1	1·27	0·2
2	1·4	1·4	1·55	4·4	1·42	1·7	1·38	1·2	1·25	0·1	1·30	0·4
3	1·38	1·2	1·58	5·1	1·45	2·2	1·38	1·2	1·25	0·1	1·28	0·3
4	1·42	1·7	1·55	4·4	1·42	1·7	1·38	1·2	1·25	0·1	1·27	0·2
5	1·43	1·8	1·55	4·4	1·40	1·4	1·38	1·2	1·25	0·1	1·27	0·2
6	1·37	1·1	1·60	5·6	1·40	1·4	1·36	1·0	1·25	0·1	1·27	0·2
7	1·40	1·4	1·66	7·1	1·40	1·4	1·37	1·1	1·25	0·1	1·28	0·3
8	1·41	1·6	1·62	6·1	1·37	1·1	1·34	0·8	1·25	0·1	1·27	0·2
9	1·42	1·7	1·71	8·4	1·35	0·9	1·31	0·5	1·25	0·1	1·27	0·2
10	1·41	1·6	1·63	6·4	1·32	0·6	1·30	0·4	1·25	0·1	1·27	0·2
11	1·49	3·0	1·63	6·4	1·36	1·0	1·30	0·4	1·30	0·4	1·25	0·1
12	1·43	1·8	1·60	5·6	1·37	1·1	1·30	0·4	1·30	0·4	1·25	0·1
13	1·42	1·7	1·56	4·6	1·35	0·9	1·31	0·5	1·35	0·9	1·22	0·1
14	1·4	1·4	1·6	5·6	1·36	1·0	1·30	0·4	1·32	0·6	1·21	0·0
15	1·4	1·4	1·6	5·6	1·38	1·2	1·30	0·4	1·32	0·6	1·20	0·0
16	1·42	1·7	1·61	5·8	1·45	2·2	1·3	0·4	1·32	0·6	Creek	dry.
17	1·52	3·6	1·67	7·4	1·42	1·7	1·3	0·4	1·30	0·4		
18	1·47	2·6	1·7	8·1	1·40	1·4	1·3	0·4	1·30	0·4		
19	1·45	2·2	1·7	8·1	1·36	1·0	1·3	0·4	1·30	0·4		
20	1·50	3·2	1·7	8·1	1·36	1·0	1·28	0·3	1·30	0·4		
21	1·47	2·6	1·7	8·1	1·35	0·9	1·26	0·2	1·30	0·4		
22	1·55	4·4	1·7	8·1	1·32	0·6	1·31	0·5	1·27	0·2		
23	1·52	3·6	1·7	8·1	1·31	0·5	1·29	0·3	1·27	0·2		
24	1·57	4·8	1·7	8·1	1·33	0·7	1·30	0·4	1·27	0·2		
25	1·50	3·2	1·7	8·1	1·36	1·0	1·35	0·9	1·27	0·2		
26	1·50	3·2	1·7	8·1	1·35	0·9	1·3	0·4	1·27	0·2		
27	1·50	3·2	1·67	7·4	1·35	0·9	1·28	0·3	1·27	0·2		
28	1·48	2·8	1·62	6·1	1·33	0·7	1·27	0·2	1·27	0·2		
29	1·50	3·2	1·68	7·6	1·31	0·5	1·27	0·2	1·25	0·1		
30	1·48	2·8	1·53	3·8	1·32	0·6	1·25	0·1	1·25	0·1		
31			1·50	3·2			1·25	0·1	1·27	0·2		

Monthly Discharge of Robbin's Creek, near Albert Duck's, for 1912.

(Drainage area, 15 square miles.)

Month.	Discharge in Second-Feet.				Run Off.		Rain
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April.....	4·8	0·4	2·3	·15	·17	137	
May.....	8·4	2·8	6·3	·42	·48	387	
June.....	2·6	0·5	1·2	·08	·09	71	
July.....	1·2	0·1	0·6	·04	·05	37	
August.....	0·9	0·1	0·3	·02	·02	18	
September.	0·4	0	0·1	·01	·01	6	
The period.							12

Note.—In 1912, Robbin's creek ran dry about the middle of September. These measurements do not include the water that is diverted above the gauging station, and conducted to the storage reservoir at Buce lake.

Accuracy, "B."

Rushton Creek (115).

Rushton creek rises in Rushton lake at an elevation of 700 feet, and discharges into Pitt lake on the east side in township 5-4-7, opposite Goose island, at an elevation of 10 feet. It is part of the Pitt-Fraser drainage. The watershed is in the Coast district, with a mean annual precipitation of about 60 inches. The stream does not freeze over at the mouth, but in the higher altitudes the winter conditions are more severe.

Mr. E. J. Fader, of New Westminster, proposes to develop power on Rushton creek. Rushton lake is 700 feet above Pitt lake, and only three-quarter mile distant. Below the lake there is a fall about 100 feet high, only one-quarter mile from Pitt lake. The water is to be diverted above the fall and conveyed in a flume and pipe line to the power-house near Pitt lake. Rushton lake could be used for storage. The power is to be used to run a quarry and gravel screening plant.

A station was established on Rushton creek on November 3, 1912, and gauge readings are being taken three times a week. There is a vertical staff gauge just at the lower end of the canyon, below the fall, and one-quarter mile from Pitt lake. The meter measurements are made by wading at a section 100 feet below the gauge. During the season of 1913 sufficient meter measurements will be taken to locate the rating curve.

One current meter measurement was made on November 3, 1912, and the discharge was 63·6 cubic feet per second. This was above the low-water flow and might be a little below the average flow that could be obtained.

Salmon River (302-304).

Salmon river rises in the hills, about 20 miles south of Grand Prairie, at an elevation of 4,500 feet, its source being separated from the Okanagan watershed by a low divide. Thence it flows in a westerly direction, for about 18 miles, to the outlet of Fish lake. From that point it makes a sharp turn and flows northerly for 17 miles,

From Grand Prairie it flows easterly for 20 miles, turns sharply and flows north for 20 miles, emptying into Shuswap lake at Salmon Arm, at an elevation of 1,150 feet. Salmon river varies from 30 feet to 50 feet in width, from 1 foot to 6 feet in depth, and has a mean velocity of from 1 foot to 3 feet per second.

From its source to about the east boundary of township 17-12-6, just east of the mouth of Bolean creek, Salmon river is wholly within the Dry Belt, and the mean annual precipitation is about 12 inches. Below Bolean creek the precipitation (25 inches) during the growing season is nearly normal and irrigation is not required.

Grand Prairie is an excellent irrigation farming district lying in a bowl-shaped expansion of Salmon river valley, at an elevation of about 1,800 feet. It is about 18 miles due south of the C.P.R. at Ducks. The projected branch of the Canadian Northern Pacific from Kamloops to the Okanagan will pass through Grand Prairie.

Grand Prairie is about 4 or 5 miles long (east and west) and about 2 miles wide, comprising over 6,000 acres of good irrigable land, in the main open and almost level country. About one-half is at present under cultivation. It is suitable for any kind of mixed farming, vegetables, grain, hay, stock raising and for fruit.

For irrigation, Grand Prairie obtains most of its water supply from Salmon river, augmented by Ingram creek and Essell creek. The run-off of Salmon river would be ample for the irrigation needs if the surplus waters of the May and June flood could be stored. This, however, is probably not feasible.

Above Grand Prairie there is very little farming land, the country being a rolling and broken plateau, covered with bull pine and some fir; irrigation is not necessary below Bolean creek and Warren creek. At the lower easterly end of Grand Prairie, Salmon river flows through swampy meadows, in which the waters of the river are partly retarded and stored, consequently Salmon river below these meadows is more uniform in its flow than at Wood's ranch. Salmon river near its mouth is a slow stream, running through a flat and marshy country.

Salmon River at Woods' Ranch (302).—The station on Salmon river at Woods' ranch was established on May 21, 1911, by C. E. Richardson. The measuring section is located on the downstream side of the bridge at Woods' ranch, 4 miles west of Grand Prairie, on the road to Fish lake. The gauge is a standard vertical staff, 6½ feet long. It is fastened to a cribbing on the left bank of the river (looking downstream) 25 feet above the bridge. Measurements are made with a Price electric current meter (small) and from 6½ to 15 pounds of lead, suspended by a cable. The initial point for sounding is on the lower side of this bridge, at the left abutment. The river flows north at the station, and above it the channel is straight for 25 feet. The river is confined between the bridge abutments for all stages, and the depth varies from 6 inches to 6 feet. The bed of the stream is rocky; but the chance of shifting is slight. Three bench-marks were established and referred to the gauge datum. It is claimed that the water sinks shortly above Woods' ranch. In 1911, W. M. Carlyle measured above the supposed location of sinking and at Woods' ranch. The results showed a difference of 2 c.f.s., the discharge above Woods' ranch being 4 c.f.s., and at the station 2 c.f.s.

SESSIONAL PAPER No. 25f

DISCHARGE MEASUREMENTS of Salmon River, at Woods' Ranch near Grand Prairie, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 21	C. G. Cline	1046	42·0	72·7	4·2	4·00	304
May 21	C. E. Richardson	1048	38·5	75·8	4·0	4·00	306
June 5	"	1048	38·0	58·0	3·6	3·52	210
July 12	W. M. Carlyle	1044	34·0	28·7	2·2	2·71	65
July 26	"	1044	16·0	10·4	1·2	1·97	12·2
Aug. 24	"	1044	9·0	3·3	0·6	1·66	2·1
1912.							
May 10	C. E. Richardson	1048	39	132	4·4	5·20	580
July 17	"	1048	20	34·7	1·6	2·55	56

Daily Gauge Height and Discharge of Salmon

Day.	March.		April		May.		June.	
	Gauge height	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1				17		170	3·75	252
2				17		200	3·80	266
3				17		219	3·80	266
4				17		240	3·65	227
5				17		280	3·52	197
6				18		318	3·42	174
7				18		296	3·35	160
8				18		274	3·30	150
9				18		252	3·22	136
10				18		228	3·20	132
11				20		209	3·25	141
12				22		200	3·28	146
13				24		192	3·22	136
14				24		210	3·20	132
15				25		228	3·20	132
16				26		330	3·10	116
17				26		433	3·05	108
18				27		400	2·98	98
19				28		350	2·92	90
20				42		325	2·88	85
21				56	4·0	322	2·78	72
22				70	4·0	322	2·82	77
23		11·		86	3·9	294	2·85	81
24		34·		103	3·8	266	2·78	72
25		30·		104	3·68	234	2·70	64
26		26·		106	3·62	220	2·65	59
27		21·		108	3·55	204	2·72	66
28		16·		110	3·5	192	2·68	62
29		16·		130	3·45	180	2·60	54
30		16·		150	3·5	192	2·55	50
31		16·			3·62	220		

SESSIONAL PAPER No. 25f

River, at Woods' Ranch near Grand Prairie, for 1911.

July.		August.		September.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
2·52	48	1·80	6·8	1·15	0·0	1
2·60	54	1·80	6·8	0·85	0 0	2
2·52	48	1 78	6·1	0·75	0 0	3
2·48	44	1·75	5·1	0·60	0·0	4
2·40	38	1·75	5·1	1·10	0·0	5
2 38	37	1·78	6·1	1·62	2·4	6
2·48	44	1·92	11·4	1·60	2·2	7
2·52	48	2·02	16·	1·60	2·2	8
2·80	74	2·00	15·	1·52	0·4	9
2·82	77	1·92	11·	1·48	0·0	10
2·82	77	1·85	8·6	1·20	0·0	11
2·80	74	1·80	6 8	0·88	0 0	12
2·62	56	1·78	6·1	0·60	0·0	13
2·52	48	1·75	5·1	0·55	0 0	14
2 48	44	1·72	4·1	1·62	2·4	15
2·40	38	1·70	3·5	1·65	2·8	16
2·39	38	1·68	3·2	1·65	2·8	17
2·30	31	1·62	2·4	1·70	3·5	18
2·22	26	1·62	2·4	1·65	2·8	19
2·25	28	1·65	2 8	1·60	2·2	20
2 18	24	1 70	3 5	1·60	2·2	21
2·10	19	1·70	3·5	1·55	0·7	22
2·10	20	1·65	2·8	1·55	0·7	23
2 08	19	1·62	2 4	1·55	0·7	24
2 02	16	1·60	2·2	1·55	0 7	25
1 98	14	1 58	1·0	1·55	0 7	26
1 92	11	1·45	0 0	1·48	0 0	27
1·88	9·7	1·20	0 0	1·28	0 0	28
1·88	9 7	1 08	0·0	1·00	0 0	29
1·85	8·6	1·40	0 0	0 88	0 0	30
1·82	7·5	1·40	0·0			31

MONTHLY DISCHARGE of Salmon River, at Woods' Ranch, near Grand Prairie, for 1911.

(Drainage area, 180 square miles.)

Month.	Discharge in Second-Feet.				Run Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
March	34	10	10	0·05	0·06	615	
April	150	17	48·7	0·27	0·30	2,900	
May	433	170	258	1·43	1·65	15,864	
June	266	50	126·7	0·7	0·78	7,540	
July	77	7·5	36·4	0·2	0·23	2,238	
August	16	0	4·8	0·03	0·03	295	
September	3·5	0	1·	0·0	0·0	60	
The period	433	0	40	0·22	3·0	29,500	12

NOTE.—The station on Salmon river at Woods' ranch was established on May 21, and continued until the end of September. From March 23 till May 20, measurements were taken by Messrs. Canavan & Mitchell, civil engineers, in the interests of a private irrigation company at Grand Prairie. Their data have been used to complete the irrigation season. Mean for seven months=69 c.f.s. Winter conditions existed from November to March.

Accuracy, "A."

DAILY GAUGE HEIGHT AND DISCHARGE of Salmon River, at Woods' Ranch, near Grand Prairie, for 1912.

Day.	April.		May.		June.		July.		August.		September.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	1·9	9·0	3·65	235	3·77	260	2·6	58	2·15	21	1·8	5·5
2	1·95	11·0	3·67	240	3·67	240	2·62	61	2·12	20	1·82	6·4
3	1·92	10·0	3·8	264	3·6	224	2·67	67	2·1	18	1·95	9·0
4	1·95	11·0	3·9	285	3·5	205	2·70	70	2·1	18	1·95	11·
5	1·95	11·0	4·05	316	3·42	190	2·6	58	2·1	18	1·95	11·
6	1·95	11·0	4·17	344	3·4	186	2·6	58	2·1	18	1·95	11·
7	2·05	15·5	4·37	390	3·35	177	1·65	64	2·05	15	2·0	13·
8	2·05	15·5	4·8	4.00	3·35	177	2·6	58	2·02	14	2·05	15·
9	2·22	26·	5·37	625	3·42	190	2·6	58	1·97	12	2·0	13
10	2·32	33·	5·22	588	3·35	177	2·6	58	1·9	9·0	1·95	11·
11	2·52	50·	5·0	533	3·25	158	2·55	53	1·9	9·0	1·95	11·
12	2·6	58·0	4·9	510	3·27	164	2·57	56	1·9	9·0	1·93	10·
13	2·6	58·	5·1	557	3·3	168	2·65	64	1·9	9·0	1·87	8·1
14	2·7	70·	5·4	630	3·25	158	2·67	67	1·9	9·0	1·85	6·4
15	2·75	76·	5·62	685	3·42	190	2·6	58	1·92	10·		
16	2·87	92·	5·6	680	3·82	270	2·6	58	1·97	12·		
17	2·95	105·	5·22	588	3·67	240	2·52	50	2·0	13·		
18	2·92	100·	4·97	527	3·47	200	2·47	46	2·02	14		
19	2·97	110·	4·72	470	3·3	168	2·42	41	2·05	15		
20	3·00	112·	4·77	480	3·22	153	2·4	39	2·05	15		
21	3·00	112·	5·12	563	3·12	135	2·4	39	2·05	15		
22	3·12	135·	5·0	533	3·07	126	2·37	37	2·0	13·		
23	3·17	145·	4·8	487	2·97	108	2·3	31	1·97	12·		
24	3·3	168·	4·72	470	2·87	93	2·3	31	1·87	8·0		
25	3·32	172·	4·57	433	2·8	82	2·3	31	1·85	7·2		
26	3·3	168·	4 5	416	2·75	76	2·3	31	1·85	7·2		
27	3·25	160·	4·47	410	2·7	70	2·27	30	1·85	7·2		
28	3·3	168·	4·4	394	2·67	67	2·25	27	1·82	6·4		
29	3·45	193·	3·3	372	2·6	58	2·22	26	1·8	5 5		
30	3·67	240·	4·02	310	2·6	58	2·2	24	1·8	5·5		
31			3·85	275			2·2	24	1·8	5·5		

MONTHLY DISCHARGE of Salmon River, at Woods' Ranch, near Grand Prairie, for 1912.
(Drainage area, 180 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	240	9	88·3	0·49	0·55	5,254	
May	685	235	455	2·52	2·90	27,977	
June	270	58	159	0·88	0·98	9,461	
July	70	24	47·8	0·26	0·30	2,940	
August	21	5·5	12·	0·07	0·08	735	
September	15	6	6	0·03	0·03	357	
The period	685	5·5	65	0·36	5·0	48,500	15

NOTE.—Mean for six summer months, 128 c.f.s. Station maintained during irrigation season. Winter conditions existed during December, January, February and March.
Accuracy, "A."

Salmon River, near Slahaltkan (*303*).—The station on Salmon river at Slahaltkan was established on May 23, 1911, by C. E. Richardson. The measuring section is located below the mouth of Bolean creek on the downstream side of the highway bridge at Slahaltkan, 10 miles east of Grand Prairie, on the road to the Okanagan. The gauge is a standard vertical staff fastened on the downstream side of the left abutment of the bridge. Measurements were made with a Price electric current meter and bridge equipment. The initial point for sounding is the left abutment of the bridge. The channel above and below the station is straight for 200 feet, and the water is fairly swift. The river is confined between the bridge abutments, and varies in depth from 1 foot to 6 feet. Three bench-marks were established and referred to the gauge datum.

The river is narrow below the station and trees overhang the banks. There is a chance of logs catching and the water being backed on the gauge. The station has been satisfactory, and the results are accurate.

DISCHARGE MEASUREMENTS of Salmon River, near Slahaltkan, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 23	C. E. Richardson	1648	30	96·	4·4	2·37	422
May 23	C. E. Richardson	1048	30	94	4·3	2·37	407
June 16	W. M. Carlyle	1044	30	74	3·2	1·68	238
July 11	"	1044	30	64	2·8	1·50	176
July 25	"	1044	30	44	1·6	1·00	72
Aug. 19	"	1044	30	42	1·2	0·81	52
Aug. 21	"	1044	29	42	1·2	0·80	49
1912.							
May 13	C. E. Richardson	1048	30·	120	5·9	2·90	708
July 16	"	1048	29·	58	2·7	1·25	155
Aug. 28	"	1049	24·	31	1·5	0·80	51

DAILY GAUGE HEIGHT AND DISCHARGE of

DAY.	MAY.		JUNE.		JULY.		AUGUST.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			2·45	441	1·31	135	·90	63·7
2			2·49	453	1·29	130	·89	62·3
3			2·38	420	1·24	122	·86	58·0
4			2·25	381	1·20	114	·85	56·6
5			2·15	352	1·18	110	·85	56·6
6			2·08	331	1·18	110	·81	50·9
7			2·02	315	1·19	112	1·00	78·7
8			1·96	298	1·64	211	1·05	87·2
9			1·94	284	1·65	214	·98	75·7
10			1·89	278	1·52	182	·92	66·7
11			1·86	270	1·52	182	·92	66·7
12			1·96	298	1·39	152	·90	63·7
13			1·94	292	1·32	137	·85	56·6
14			1·85	267	1·26	125	·82	52·3
15			1·75	240	1·25	124	·82	52·3
16			1·69	224	1·25	124	·81	50·9
17			1·64	211	1·20	114	·80	49·5
18			1·56	191	1·15	105	·80	49·5
19			1·51	179	1·11	97	·80	49·5
20			1·45	166	1·09	94	·80	49·5
21			1·36	146	1·06	89	·80	49·5
22			1·41	156	1·05	87	·82	52·3
23	2·38	420	1·39	152	1·04	86	·82	52·3
24	2·30	396	1·39	152	1·01	80	·80	49·5
25	2·22	372	1·34	141	·98	76	·78	46·9
26	2·18	360	1·35	144	·98	76	·75	43·0
27	2·11	340	1·40	154	·96	73	·72	39·1
28	2·05	323	1·35	144	·94	70	·72	39·1
29	2·05	323	1·30	133	·92	67	·72	39·1
30	2·16	354	1·29	129	·91	65	·72	39·1
31	2·32	402	....		·90	64	·72	39·1

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Salmon River, near Slahaltkan, for 1911.

September.		October.		November.		December.		
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Day.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
·72	39·1	·75	43·0	·69	35·2	·71	39·1	1
·72	39·1	·75	43·0	·68	34·9	·71	39·1	2
·74	41·7	·75	43·0	·68	34·9	·70	36·5	3
·70	48·[illegible]	·72	39·1	·70	37·8	·70	[illegible]	4
·78	[illegible]·9	·72	39·1	·71	37·8	·70	36·9	5
·78	46·9	·72	39·1	·74	41·7	·69	35·2	6
·78	46·9	·72	39·1	·72	39·1	·68	34·0	7
·78	46·9	·70	36·5	·72	39·1	·68	34·0	8
·78	46·9	·70	36·5	·72	39·1	·70	36·5	9
·76	44·3	·70	36·5	·72	39·1	·70	36·5	10
·75	43·0	·70	36·5	·72	39·1	·68	34·0	11
·78	46·9	·70	36·5	·72	39·1	·68	34·0	12
·81	50·9	·70	36·5	·72	39·1	·69	35·2	13
·89	62·3	·70	36·5	·72	39·1	·70	36·5	14
·86	58·0	·70	36·5	·72	39·1	·70	36·5	15
·85	56·6	·70	36·5	·75	43·0	·70	36·5	16
·82	52·3	·70	36·5	·74	41·7	·70	36·5	17
·80	49·[illegible]	·70	36·5	·75	43·0	·70	36·5	18
·80	49·[illegible]	·70	36·5	·76	44·3	·70	36·5	19
·78	46·9	·70	36·5	·75	43·0	·70	36·5	20
·75	43·0	·70	36·5	·72	39·1	·68	34·0	21
·75	43·0	·70	36·5	·72	39·1	·69	35·2	22
·75	43·0	·70	36·5	·72	39·1	·66	26·5	23
·74	41·7	·70	36·5	·72	39·1	·[illegible]	[illegible]	24
·72	39·1	·70	36·5	·72	39·1	·[illegible]	66·7	25
·72	39·1	·70	36·5	·73	41·7	·[illegible]	[illegible]	26
·72	39·1	·70	[illegible]	·86	58·0	·[illegible]	41·7	27
·72	39·1	·70	[illegible]	[illegible]	72·0	[illegible]	[illegible]	[illegible]
·72	[illegible]	·70	36·5	·80	49·[illegible]	[illegible]	[illegible]	[illegible]
·75	43·0	·70	36·5	·72	[illegible]	[illegible]	[illegible]	30
		·70	36·5					31

Monthly Discharge of Salmon River near Slahaltkan for 1911.

(Drainage area, 350 square miles.)

Month.	Discharge in Second-Feet.					Run-off.	
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	453	129	245	·70	·78	14,600	
July	214	64	114	·33	·38	7,010	
August	87	39	54	·15	·17	3,320	
September	62	39	[illegible]	·13	·14	[illegible]	
October	43	[illegible]	37	[illegible]	·13	2,275	
November	73	34	41	·12	·13	2,440	
December	67	26	37	·11	·13	2,275	
The period							12

Note.—Partial winter conditions existed during November and December. Discharges are deduced from a curve, applicable only to open flow conditions. The discharges given for these two months are therefore probably slightly too large.

Accuracy, "A."

DAILY GAUGE HEIGHT AND DISCHARGE of

Day.	JANUARY.		FEBRUARY.		MARCH.		APRIL		MAY.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1.....	0·75	41·0	0·70	32·0	0·69	30·2	0·77	44·6	1·80	248
2.....	0·74	39·2	0·70	32·0	0·62	17·6	0·77	44·6	1·80	248
3.....	0·75	41·0	0·70	32·0	0·60	14·0	0·80	50·0	1·86	262
4.....	0·75	41·0	0·69	30·2	0·67	26·6	0·77	44·6	2·02	304
5.....	0·75	41·0	0·65	23·0	0·60	14·0	0·76	42·8	2·13	335
6.....	0·80	50·0	0·65	23·0	0·60	14·0	0·76	42·8	2·22	362
7.....	0·79	48·0	0·65	23·0	0·60	14·0	0·73	37·4	2·33	399
8.....	0·75	41·0	0·65	23·0	0·62	17·6	0·76	42·8	2·53	490
9.....	0·80	50·0	0·67	26·6	0·62	17·6	0·81	51·7	2·65	555
10.....	0·80	50·0	0·70	32·0	0·62	17·6	0·83	55·	2·67	566
11.....	0·80	50·0	0·67	26·6	0·62	17·6	0·93	73·	2·70	583
12.....	0·80	50·0	0·70	32·0	0·62	17·6	0·98	81·	2·85	675
13.....	0·70	32·0	0·70	32·0	0·62	17·6	0·97	80·	2·95	738
14.....	0·67	26·6	0·70	32·0	0·60	14·0	1·00	85·	3·22	914
15.....	0·70	32·0	0·70	32·0	0·60	14·0	1·05	94·	3·35	1,005
16.....	0·70	32·0	0·70	32·0	0·60	14·0	1·05	94·	3·45	1,075
17.....	0·70	32·0	0·67	26·6	0·60	14·0	1·07	98·	3·42	1,054
18.....	0·70	32·0	0·67	26·6	0·60	14·0	1·16	114·	3·25	935
19.....	0·70	32·0	0·67	26·6	0·60	14·0	1·20	122·	3·20	900
20.....	0·70	32·0	0·67	26·6	0·60	14·0	1·20	122·	3·20	900
21.....	0·70	32·0	0·67	26·6	0·60	14·0	1·25	132·	3·20	900
22.....	0·70	32·0	0·67	26·6	0·60	14·0	1·36	154·	3·20	900
23.....	0·70	32·0	0·67	26·6	0·60	14·0	1·40	162·	3·20	900
24.....	0·70	32·0	0·67	26·6	0·65	23·0	1·50	182·	3·15	867
25.....	0·80	50·0	0·65	23·0	0·72	35·6	1·55	192·	3·05	802
26.....	0·74	39·2	0·65	23·0	0·73	37·4	1·57	196·	2·86	681
27.....	0·67	26·6	0·64	21·2	0·77	44·6	1·57	196·	2·70	583
28.....	0·67	26·6	0·66	24·8	0·80	50·0	1·60	203·	2·57	511
29.....	0·70	32·0	0·70	32·0	0·73	37·4	1·60	203·	2·50	474
30.....	0·80	50·0			0·71	33·8	1·72	230·	2·47	460
31.....	0·72	35·6			0·76	42·8			2·37	415

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Salmon River, near Slahaltkan, for 1912.

June.		July.		August.		September.		Day
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
2·25	372	1·25	132	0·97	80	0·87	62	1
2·17	347	1·30	142	0·96	78	0·90	67	2
2·10	326	1·34	150	0·95	76	0·90	67	3
2·02	304	1·30	142	0·95	76	0·90	67	4
1·92	277	1·28	138	0·95	76	0·87	62	5
1·86	262	1·30	142	0·93	72	0·87	62	6
1·78	243	1·35	152	0·90	67	0·95	76	7
1·76	238	1·30	142	0·88	64	0·95	76	8
1·72	230	1·24	130	0·90	67	0·90	67	9
1·70	225	1·23	128	0·88	64	0·87	62	10
1·67	218	1·25	132	0·87	62	0·87	62	11
1·68	221	1·23	128	0·87	62	0·87	62	12
1·72	230	1·30	142	0·87	62	0·87	62	13
1·80	248	1·30	142	0·86	60			14
2·00	298	1·28	138	0·86	60			15
1·90	272	1·26	134	0·90	67			16
1·85	260	1·20	122	0·90	67			17
1·77	241	1·18	118	0·90	67			18
1·65	214	1·16	114	0·88	64			19
1·58	199	1·11	105	0·87	62			20
1·55	192	1·10	103	0·87	62			21
1·50	182	1·10	103	0·87	62			22
1·47	176	1·08	99	0·87	62			23
1·40	162	1·08	99	0·83	55			24
1·32	146	1·12	107	0·82	53			25
1·30	142	1·10	103	0·82	53			26
1·27	136	1·07	98	0·80	50			27
1·24	130	1·05	94	0·80	50			28
1·20	122	1·02	89	0·78	46			29
1·25	132	0·98	81	0·81	52			30
		0·97	80	0·86	60			31

MONTHLY DISCHARGE of Salmon River, near Slahaltkan, for 1912.
(Drainage area, 350 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAIN-FALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
January..	50	27	38	·11	·13	2,340	
February...	32	21	28	·08	·09	1,610	
March....	35	14	22	·06	·07	1,350	
April..	230	37	109	·31	·35	6,490	
May.....	1,075	248	646	1·85	2·13	39,700	
June.....	372	122	225	·64	·71	13,400	
July.....	152	80	120	·34	·39	7,380	
August...	80	46	63	·18	·21	3,870	
The period.. ..							16

NOTE.—Partial winter conditions existed during January and February. Discharges are deduced from a curve, applicable only to open flow conditions. The discharges given for these two months are therefore, probably slightly too large. Accuracy, "C."
Station abandoned September 13, 1912.
From March to August, Accuracy "A."

Salmon River, near Salmon Arm (304).—The station on Salmon river at Salmon Arm was established on June 2, 1911, by C. E. Richardson. The measuring section is located on the downstream side of the new bridge at Vavasour's ranch, 4 miles from Salmon Arm and 3 miles from the mouth of the river. The gauge is a standard vertical staff fastened to a pile on the left end of the downstream side of the bridge. Measurements are made with a Price small electric meter and bridge equipment during high water, and by wading during low water. The initial point for sounding is at the right abutment on the downstream side of the bridge. The channel above and below the station is straight for 150 feet and the water is not very swift. The water passes between the bridge abutments at all stages, and is from 2 feet to 7 feet deep. The bed of the stream is silt, and has a tendency to shift. The water flows diagonally under the bridge, but the flow is fairly uniform. Three bench-marks were established and referred to the gauge datum.

DISCHARGE MEASUREMENTS of Salmon River, near Salmon Arm, 1911-12.

Date.	Hydrographer.	Meter No.	Width	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
June 2	C. E. Richardson.	1048	170	483	1·6	4·4	766
June 12...	"	1048	125	321	1·7	3·47	557
June 27...	"	1048	80	162	2·0	1·85	318
Aug. 1...	"	1048	42	59	1·7	0·40	102
Aug. 30...	"	1048	40	35	1·5	0·15	52·7
Oct. 5....	"	1048	40	37	1·6	0·10	58·1
1912.							
May 19....	"	1055	75	416	2·5	4·35	1,000
June 14...	"	1048	82	184	2·4	2·10	450
Sept. 6...	"	1049	45	51	1·7	0·19	88

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Daily Discharge of Salmon River, near Salmon Arm, for 1911.

Day.	June.	July.	August.	September.	October.	November.
	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.
	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.
1	600	271	91·0	56·9	[illegible]	[illegible]
2	600	240	86·2	55·8	[illegible]	47·0
3	600	222	[illegible]	52·[illegible]	[illegible]	47·0
4	645	203	[illegible]	53·6	[illegible]	[illegible]
5	611	193	79·0	66·[illegible]	[illegible]	47·0
6	560	183	[illegible]	68·0	[illegible]	[illegible]
7	558	193	125	68·0	[illegible]	[illegible]
8	523	240	151	[illegible]	[illegible]	[illegible]
9	514	340	128	[illegible]	[illegible]	55·8
10	514	317	101	63·0	[illegible]	52·5
11	532	312	95·[illegible]	[illegible]	[illegible]	.....
12	571	268	91·[illegible]	[illegible]	[illegible]	.....
13	578	225	[illegible]	63·[illegible]	[illegible]	
14	584	[illegible]	81·[illegible]	[illegible]	[illegible]	
15	532	189	[illegible]	88·6	[illegible]	.....
16	[illegible]	182	79·0	79·[illegible]	[illegible]	.....
17	406	171	76·[illegible]	73·5	[illegible]	
18	371	157	74·0	[illegible]	[illegible]	.....
19	340	[illegible]	70·[illegible]	[illegible]	[illegible]	.....
20	328	142	76·[illegible]	[illegible]	[illegible]	.....
21	303	136	68·[illegible]	66·[illegible]	[illegible]	.....
22	290	128	[illegible]	[illegible]	[illegible]	.....
23	283	127	68·[illegible]	[illegible]	[illegible]	
24	279	123	68·0	58·0	[illegible]	.....
25	271	118	66·[illegible]	58·0	[illegible]	.....
26	258	115	63·[illegible]	58·[illegible]	[illegible]	
27	290	113	63·0	58·0	[illegible]	
28	263	105	[illegible]	58·0	[illegible]	
29	243	103	63·0	[illegible]	[illegible]	
30	240	93	63·0	[illegible]	[illegible]	
31		91	58·0		[illegible]	

Monthly Discharge of Salmon River, near Salmon Arm, for 1911.

(Drainage area, 530 square miles.)

Month.	Discharge in Second-feet.				Run-Off.		Rain-fall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	645	240	[illegible]	·83	·93	26,100	
July	340	91	182	·34	·39	11,200	
August	151	58	82	·15	·17	5,050	
September	89	53	63	·12	·13	3,750	
October	56	47	50	·09	·10	3,075	
The period							15

Note.—River froze about November 10, 1911, and opened again March 24, 1912. Channel at station shifted at the time of the May flood, 1912, and a new curve was made for all discharges subsequent to May 1, 1912.

Accuracy, "B."

Daily Discharge of Salmon River, near Salmon Arm, for 1912.

Day.	March.	April.	May.	June.	July.	August.	September.
	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.
	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.
1		87	402	654	209	105	86
2		90	410	624	223	100	122
3		110	402	579	246	96	109
4		122	432	542	253	91	104
5		113	463	524	232	84	100
6		111	483	492	237	73	91
7		110	512	463	246	73	113
8		113	569	471	251	73	131
9		128	637	463	232	73	136
10		143	710	441	211	68	109
11		171	720	424	195	73	87
12		190	745	432	214	73	82
13		183	795	443	216	68	82
14		178	865	449	216	64	73
15		170	967	461	204	68	69
16		168	1,070	532	195	77	64
17		170	1,075	473	184	75	64
18		186	1,028	443	173	75	64
19		192	1,009	414	158	73	59
20		193	1,005	386	154	73	57
21		201	1,044	331	145	73	55
22		207	1,028	303	136	68	55
23		216	1,032	260	145	64	55
24	21·2	235	1,070	241	141	64	59
25	21·2	252	1,028	237	145	66	59
26	39·4	260	1,005	237	167	60	6
27	61·8	263	997	237	154	59	64
28	73·0	265	902	230	145	59	60
29	87·5	267	828	219	136	59	60
30	77·2	298	762	214	127	59	60
31	83·0		688		109	68	

Monthly Discharge of Salmon River, near Salmon Arm, for 1912.

(Drainage area, 530 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	298	87	179	·34	·38	10,650	
May	1,075	402	796	1·50	1·73	48,950	
June	654	214	407	0·77	0·86	24,200	
July	253	109	187	·35	·40	11,500	
August	105	59	73	·14	·16	4,500	
September	136	5	80	·15	·17	4,750	
The period							16

Note.—River opened about March 24, 1912. Station abandoned September 30, 1912
Accuracy, "B."

Scottie Creek (219).

Scottie creek has its source in the Arrowstone hills, at an elevation of 5,000 feet, and discharges into Bonaparte river from the east, near the 19-mile post on the Cariboo road, at an elevation of 1,600 feet. It is part of the Thompson-Fraser drainage. The drainage area above the mouth is 73 square miles, and the gauging station is near the mouth. The water is used for irrigation, and the supply is usually insufficient. Water from Scottie creek was used for placer mining at one time.

The drainage basin of Scottie creek is very rough, with no agricultural land. There are canyons on the streams in places, and the fall is quite heavy. There is a wagon road for only half a mile up the creek, with a pack trail for several miles farther. There was a placer mine in the valley at one time, but it has been abandoned. There are indications of mineral in the vicinity. There is some timber in the valley, but it is mostly small, and its main use would be to conserve the moisture and prevent erosion. Most of the land in the watershed will be used for nothing but grazing.

At one of the canyons a storage dam might be constructed to store the surplus flood waters for use in the latter part of the irrigation season. The canyon is said to be 30 feet deep and 20 feet wide, with a good basin behind it.

Scottie creek is in the Dry Belt. The precipitation is from 8 to 10 inches. The weather is hot in summer and cold in winter.

The gauge on Scottie creek is near the mouth, just above Mr. Walker's diversion. Since the station was established, Mr. Hunter has dug a ditch above it, and was diverting water through it during part of July and August, 1912. The station was established on June 6, 1911, and the gauge readings were taken twice a day during the irrigation seasons of 1911 and 1912 by M. F. Ahearn. The gauge is a 5-foot cedar staff, securely nailed to a tree stump on the left bank of the creek about 200 feet above Walker's diversion and just behind Hunter's stable. The meter measurements are made by wading at a section 50 feet below the gauge. The stream above the section is rapid, and below the section it is backed up by the diversion dam. The banks are high enough to prevent overflowing, and are covered with bushes. The bed of the stream is rocky in the rapids, with a deposit of mud in the quieter water at the dam. The influence of the dam does not extend to the gauge. It is hard to read the gauge accurately at high water. The general level of the water near the gauge should be taken, not the point to which the water backs up. The bank is undercut at the gauge, but it does not seem to affect the accuracy.

Discharge Measurements of Scottie Creek, above diversions, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
June 6	C. G. Cline.	1046	12·5	6·2	0·9	0·60	6·0
July 16	"	1055	9·0	4·2	0·6	0·44	2·5
Sept. 28	Cline and Smith	1046	12·	5·5	0·7	0·50	3·8
1912.							
Apr. 25	C. G. Cline.	1046	10·	7·6	1·3	0·85	10·2
May 19	"	1046	23·	16·3	2·0	1·09	33·
May 18	"	1046	23·	14·8	1·8	1·00	25·
June 19	Corbould and Cline.	1046	11·	4·5	1·2	0·[illegible]	5·7
July 10	B. Corbould	1044	11·8	5·5	1·3	0·[illegible]	7·4
Aug. 2	"	1044	6·5	5·3	1·0	0·[illegible]	5·3
Aug. 28	"	1044	9·5	3·6	0·9	0·[illegible]	3·0

GAUGE HEIGHTS AND DAILY DISCHARGE of Scottie Creek, above diversions, for 1911.

Day.	JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	5·8	0·55	4·8	0·4	2·0	.....	3·1	.....	3·8
2	.....	5·8	.....	4·3	.....	2·3	.....	3·2	.....	3·8
3	.....	5·8	0·5	3·8	.....	2·6	.....	3·4	0·5	3·8
4	.....	5·8	0·5	3·8	.....	2·9	.....	3·6	.....	3·8
5	.....	5·8	0·48	3·4	.....	3·2	0·5	3·8	.....	3·8
6	0·6	5·8	0·49	3·6	.....	3·4	.....	3·5	.....	4·0
7	0·6	5·8	.....	3·7	.....	3·6	.....	3·2	.....	3·9
8	0·6	5·8	0·5	3·8	0·5	3·8	.....	2·9	.....	3·9
9	0·6	5·8	0·5	3·8	0·5	3·8	.....	2·6	.....	4·0
10	0·6	5·8	.....	3·6	.....	3·5	.....	2·4	.....	4·0
11	0·6	5·8	.....	3·4	.....	3·2	.....	2·2	0·51	4·0
12	0·57	5·2	.....	3·2	.....	2·9	0·4	2·0	.....	4·1
13	0·57	5·2	.....	3·0	.....	2·6	.....	2·2	.....	4·2
14	0·55	4·8	.....	2·8	0·42	2·4	.....	2·4	.....	4·3
15	0·52	4·2	.....	2·6	0·4	2·0	.....	2·6	.....	4·4
16	0·5	3·8	.....	2·4	.....	2·2	.....	2·9	.....	4·5
17	0·5	3·8	.....	2·2	.....	2·4	.....	3·2	0·54	4·6
18	0·5	3·8	.....	2·1	.....	2·6	.....	3·5	.....	4·6
19	0·	3·8	0·4	2·0	.....	2·8	0·5	3·8	.....	4·6
20	.....	3·8	.....	2·0	.....	3·0	.....	3·8	.....	4·7
21	0·5	3·8	.....	2·0	.....	3·2	.....	3·8	.....	4·7
22	0·5	3·8	.....	1·9	.....	3·5	.....	3·8	.....	4·7
23	0·5	3·8	.....	1·9	0·5	3·8	.....	3·8	.....	3·8
24	0·5	3·8	.....	1·8	.....	3·6	.....	3·8	0·55	4·8
25	0·5	3·8	.....	1·8	.....	3·4	.....	3·8	.....	4·4
26	0·5	3·8	0·38	1·7	.....	3·3	.....	3·8	.....	4·0
27	0·5	3·8	.....	1·7	.....	3·2	0·5	3·8	.....	3·6
28	0·5	3·8	.....	1·7	.....	3·1	.....	3·8	.....	3·2
29	0·55	4·8	.....	1·8	.....	3·0	.....	3·8	.....	2·8
30	0·55	4·8	.....	1·8	0·45	2·9	.....	3·8	.....	2·4
31	.....	.....	.....	1·9	.....	3·0	.....	.....	0·4	2·0

MONTHLY DISCHARGE of Scottie Creek, above diversions, for 1911.

(Drainage area, 70 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	5·8	3·8	4·7	0·07	0·08	280	
July	4·8	1·7	2·7	0·04	0·05	166	
August	3·8	2·0	3·0	0·04	0·05	184	
September	3·8	2·0	3·3	0·05	0·06	196	
October	4·8	2·0	4·0	0·06	0·07	246	
The period							10

NOTE.—Station established June 6, and maintained during irrigation season only.
Accuracy, "C."

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Gauge Heights and Daily Discharge of Seattle Creek, above diversions, for 1912.

Day	April.		May.		June.		July.		August.		September.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft	Feet.	Sec.-ft.	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec. ft
1....	0·7	7·8	.....	19·0	...	10·5	0·77	9·2		5·0	0·47	3·3
2....	...	7·8	1·2	20·0	.....	10·1		8·7	0·55	4·8		
3....		7·8		23·0	0·8	9·8		8·2		5·1		
4....		7·8	1·4	26·0		9·3	0·7	7·8		5·4		
5....		7·8	.....	27·5		8·8		7·8	0·6	5·8	0·6	5·8
6....		7·8	1·5	29·0		8·3		7·8		5·4		
7....		7·8	.....	35·0	0·7	7·8		7·8		10		
8....	0·7	7·8	1·45	40·0		7·8	0·7	7·8	0·5	9·8	0·5	9·8
9....		8·5	1·9	45·0		7·8		7·8		9·8		
10....		9·2	.....	37·0	0·7	7·8	0·7	7·8		3·8		
11....	0·8	9·8	1·5	29·0		7·8	0·57	5·2	0·5	3·8		
12....		9·8		28·2	0·7	7·8		5·4		4·3		
13....		9·8	1·45	27·5		8·0		5·6		4·8		
14....		9·2		26·8	0·72	8·2		5·7		5·0		
15....	0·8	9·8	1·4	26·0	.....	8·1	0·6	5·8	0·6	5·8		
16....		10·6	.....	23·0		8·0		·3		5·4		
17....	...	10·2	.....	20·0	0·7	7·8		4·8	.....	5·1		
18....	...	10·4	.....	17·0		6·8		4·2	0·55	4·8		
19....	...	10·6	1·0	14·0	0·6	5·8	0·5	3·8		4·8		
20....	...	10·7	1·0	14·0	.....	5·0		4·2		4·8		
21....	...	10·5	.....	15·0		6·4		5·8		4·8		
22....	0·85	10·9	.....	16·0	0·5	6·8		5·4	0·55	4·8		
23....	...	11·6	1·1	17·0		6·3	0·6	5·8		4·8		
24....	...	12·3	.....	16·0	0·6	5·8		6·1	0·55	4·8		
25....	0·95	13·0		14·0		6·3	.....	6·5	0·5	3·8		
26....	...	14·0	.....	13·0		6·8	0·65	6·8		3·7		
27....	...	15·0	0·9	12·0		7·3		6·5		3·6		
28....	...	16·0		10·6	0·7	7·8		6·1	.....	3·5		
29....	1·1	17·0	.....	11·2		8·4	0·6	5·8	0·47	3·3		
30....	...	18·0	0·85	10·9		8·8		5·5		3·3		
31....				10·5				5·2		4·8		

Monthly Discharge of Seattle Creek, above diversion, for 1912.

(Drainage area, 70 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April...	18·0	7·8	10·6	0·15	0·17	630	
May....	45·0	10·5	21·7	0·31	0·36	1,330	
June....	10·5	5·8	7·8	0·11	0·12	464	
July....	9·2	3·8	6·3	0·09	0·10	387	
August....	5·8	3·3	4·5	0·06	0·07	277	
The period....							10

Note.—Station maintained during irrigation season only.
Accuracy, "C."

Shuswap River (311).

Shuswap river has its source 30 miles east of Armstrong, B.C., at an elevation of 1,980 feet in Sugar lake, which is fed by tributaries rising in the Park mountains of the Gold range, at an elevation of 6,000 feet. This river is about 100 miles long and discharges into Shuswap lake near Sicamous, at an elevation of 1,150 feet.

One-half mile above the mouth the river broadens into Mara lake, a lake about 8 miles long and three-quarters of a mile wide. From Mara lake to 1 mile above Enderby, a distance of 15 miles, the river is very sluggish. Between Enderby and Mabel lake there are several rapids, and a total fall of 100 feet. Mabel lake, at an elevation of 1,270 feet, is about 25 miles long and over one-half mile in width. Above Mabel lake there are a series of rapids and one pronounced fall (Coteau falls). The distance between Mabel lake and Sugar lake is about 30 miles, and the fall is over 600 feet. Sugar lake is about 3½ miles long and 1½ miles wide.

The precipitation in the Shuswap drainage varies from 20 inches at the mouth to 30 inches near the source. The winter conditions near the mouth are mild, but at the source they are severe, with a large fall of snow. The river freezes for about three months during the winter.

Logging is the most important interest on the stream, a large saw-mill concern at Enderby (Rogers, Ltd.) owns extensive limits around Mabel lake.

At present no power is developed on Shuswap river. However, at Coteau falls, the C.N.R. is constructing a power plant which, when completed, will develop 9,000 horse-power. Good storage may be obtained on Sugar lake. Another possible development which has been investigated is located about 3 miles below Mabel lake. A head of from 30 feet to 40 feet may be obtained, and there is good storage. The mean flow of Shuswap river at this point is about 3,000 c.f.s.

Navigation is carried on between Enderby and the mouth, and during high water large vessels may ply between Enderby and Sicamous and on through Shuswap lake to Kamloops.

The drainage area of the river above the mouth is 1,700 square miles and above Enderby 1,600 square miles.

A regular gauging station was established on Shuswap river on August 25, 1911, at Enderby, B.C., by C. E. Richardson. The gauge is a vertical staff, 16 feet long, fastened to the abutment piles of the traffic bridge. Measurements are made by boat. The conditions are satisfactory for accurate results.

Discharge Measurements of Shuswap River, near Enderby, B.C., 1911-12.

Date	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft.per sec.	Feet.	Sec.-ft.
1911.							
Aug. 25....	C. E. Richardson.	1048	212	2,120	0·9	4·08	1,950*
Oct. 7...	"	1048	205	1,890	0·7	3·15	1,300*
1912.							
Feb. 28...	C. E. Richardson	1047	180	1,680	0·4	1·90	590*
May 20...	"	1048	283	4,970	2·3	10·65	11,400†
June 16...	"	1048	355	5,550	2·4	12·06	13,100†
July 13..	"	1048	275	3,760	1·7	7·34	6,270†
Sept. 7..	"	1048	245	3,160	1·1	4·6	3,280†
Oct. 5....	"	1055	210	1,710	1·0	3·55	1,720*

*Cable Station.
†Bridge Station.

DAILY GAUGE HEIGHT AND DISCHARGE of Shuswap River, near Enderby, for 1911.

Day.	August.		September.		October.		November.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			3·70	1,730	3·37	1,459	2·65	910
2			3·65	1,685	3·35	1,445	2·50	880
3			3·62	1,658	3·3	1,410	2·50	880
4			3·65	1,685	3·25	1,375	2·50	880
5			3·65	1,685	3·22	1,354	2·55	910
6			3·60	1,640	3·20	1,340	2·60	940
7			3·55	1,600	3·15	1,300	2·60	940
8			3·55	1,600	3·10	1,260	2·55	910
9			3·50	1,560	3·10	1,260	2·50	880
10			3·47	1,536	3·05	1,225	2·50	880
11			3·30	1,410	3·0	1,190		
12			3·30	1,410	3·0	1,190		
13			3·22	1,354	2·95	1,155		
14			3·35	1,445	3·0	1,190		
15			3·65	1,685	3·0	1,190		
16			3·65	1,685	2·97	1,169		
17			3·6	1,640	2·95	1,155		
18			3·6	1,640	2·9	1,120		
19			3·6	1,640	2·9	1,120		
20			3·57	1,616	2·85	1,090		
21			3·60	1,640	2·82	1,072		
22			3·58	1,624	2·80	1,060		
23			3·55	1,600	2·80	1,060		
24			3·50	1,560	2·77	1,042		
25	4·0	2,000	3·55	1,600	2·75	1,030		
26	4·0	2,000	3·47	1,536	2·70	1,000		
27	3·95	1,955	3·45	1,520	2·70	1,000		
28	3·9	1,910	3·42	1,496	2·67	982		
29	3·85	1,866	3·40	1,480	2·65	970		
30	3·80	1,820	3·37	1,459	2·60	940		
31	3·75	1,775			2·60	940		

MONTHLY DISCHARGE of Shuswap River, near Enderby, for 1911.

(Drainage area, 1,600 square miles.)

Month.	Discharge in Second-Feet.				Run Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
September	1,730	1,354	1,580	·99	1·10	94,000	
October	1,460	940	1,160	·73	·84	71,300	
[illegible]							30

NOTE.—Station established Aug. 25, 1911. River frozen up, Nov. 11, 1911.
Accuracy, "A."

DAILY GAUGE HEIGHT AND DISCHARGE

Day.	March.		April.		May.		June.		July.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	2·3	780	2·25	755	6·5	4,960	11·55	12,580	9·4	9,210
2	2·3	780	2·4	830	6·5	4,960	11·15	11,940	9·2	8,900
3	2·3	780	2·9	1,120	6·5	4,960	10·7	11,220	9·0	8,600
4	2·3	780	2·8	1,060	6·55	5,020	10·3	10,600	8·7	8,150
5	2·32	790	2·8	1,060	6·7	5,220	10·0	10,130	8·4	7,700
6	2·32	790	2·75	1,030	6·7	5,220	9·7	9,680	8·3	7,550
7	1·9	590	2·7	1,000	6·7	5,220	9·6	9,530	8·1	7,250
8	1·9	590	2·8	1,060	7·0	5,630	9·65	9,600	8·0	7,100
9	1·9	590	3·0	1,190	7·3	6,060	9·9	9,980	7·75	6,720
10	1·8	550	3·2	1,340	7·4	6,200	10·0	10,130	7·5	6,350
11	1·65	490	3·6	1,640	7·6	6,500	10·2	10,450	7·4	6,200
12	1·65	490	4·0	2,000	7·8	6,800	10·5	10,900	7·3	6,060
13	1·65	490	4·1	2,100	8·0	7,100	11·1	11,860	7·35	6,130
14	1·7	510	4·2	2,200	8·4	7,700	11·4	12,340	7·3	6,060
15	1·7	510	4·3	2,300	8·9	8,450	11·7	12,820	7·2	5,910
16	1·7	510	4·4	2,400	9·4	9,210	12·1	12,460	7·1	5,770
17	1·7	510	4·6	2,600	9·9	9,980	12·3	13,780	7·0	5,630
18	1·7	510	4·8	2,810	10·2	10,450	12·3	13,780	6·9	5,490
19	1·7	510	5·3	3,390	10·5	10,900	12·3	13,780	6·75	5,280
20	1·7	510	5·5	3,760	10·6	11,060	12·3	13,780		5,080
21	1·7	510	5·7	3,890	10·9	11,540	12·1	13,460	6·45	4,890
22	1·7	510	5·8	4,020	11·1	11,860	12·1	13,460		4,680
23	1·7	510	5·9	4,150	11·2	12,020	11·9	13,140	6·15	4,480
24	1·7	510	6·1	4,410	11·4	12,340	11·7	12,820		4,440
25	1·7	510	6·2	4,540	11·6	12,660	11·5	12,500	6·1	4,410
26	1·7	510	6·2	4,540	11·9	13,140	11·2	12,020		4,320
27	1·7	510	6·2	4,540	12·1	13,460	10·8	11,380	5·95	4,220
28	1·7	510	6·2	4,540	12·3	13,780	10·6	11,060		4,090
29	2·0	630	6·25	4,610	12·3	13,780	10·2	10,450	5·75	3,960
30	2·0	630	6·5	4,960	12·2	13,620	9·8	9,830		3,830
31	2·1	680			11·95	13,220			5·55	3,700

of Shuswap River, near Enderby, for 1912.

August.		September.		October.		November.		December.		Day.
Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
.....	3,600	4·4	2,400	[illegible]	1,640		1,660		1,540	1
5·4	3,510		[illegible]		[illegible]	3·6	[illegible]	3·45	1,520	2
[illegible]	[illegible]	4·5	2,500	[illegible]	1,560		1,640		1,520	3
5·3	3,390		[illegible]		1,580	[illegible]	1,640	[illegible]	1,520	4
.....	3,330	4·4	2,400	3·55	1,600		[illegible]		1,500	5
5·2	3,270	.....	2,500		1,540	3·55	[illegible]	3·4	1,480	6
.....	3,210	4·6	2,600	[illegible]	1,480		1,600		1,440	7
5·1	3,150	.....	2,650		1,480	3·55	1,600	3·3	1,410	8
.....	3,090	4·7	2,700	[illegible]	1,480		1,580		1,390	9
5·0	3,030	.....	2,650		1,480	[illegible]	1,560	3·25	1,370	10
.....	3,030	4·6	2,600	[illegible]	1,480		1,560		1,360	11
5·0	3,030	.....	2,580		1,480	[illegible]	1,560	3·2	1,349	12
.....	2,980	4·55	2,550	[illegible]	1,480		1,620		1,300	13
4·9	2,920	.....	2,520		1,460	3·65	1,680	3·1	1,260	14
.....	2,920	4·5	2,500	3·35	1,440		1,660		1,260	15
4·9	2,920	.....	2,480		1,500	[illegible]	1,640	3·1	1,260	16
	[illegible]	4·45	2,450	[illegible]	[illegible]		1,600		1,220	17
4·85	2,860		2,380		1,600	[illegible]	1,560	3·0	1,190	18
.....	2,840	4·3	2,300	[illegible]	1,640		1,600		1,180	19
4·8	2,810	.....	2,280		1,680	[illegible]	1,640	2·95	1,160	20
.....	2,760	4·25	2,250	[illegible]	1,730	.....	[illegible]		1,140	21
4·7	2,700	.....	2,150		1,760	3·65	1·680	2·9	1·120	22
.....	2,620	4·05	2·050	[illegible]	1,780		1·660		1·100	23
[illegible]	[illegible]	.....	2,000		1,780	3·6	1·640	2·85	1·090	24
.....	2,520	3·95	1,960	[illegible]	1,780		1.640		1,090	25
4·5	2,500		[illegible]		1,780	3·6	1·640	2·85	1,080	26
.....	2,480	3·8	1,820	3·75	1,780		1,600		1,060	27
4·45	2,450		[illegible]		1,760	3·5	1,560	2·75	1,030	28
.....	2,420	3·7	1,730	3·7	1,730		1,560		1,040	29
4·4	2,400		[illegible]	.....	1,700	3·5	1,560	2·8	1·060	30
.....	2,400			3·65	1,680				1,030	31

MONTHLY DISCHARGE of Shuswap River, near Enderby, for 1912.

(Drainage area, 1,600 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
March	790	490	585	·37	·43	36,000	
April	4,960	755	2,660	1·66	1·85	158,300	
May	13,780	4,960	9,130	5·71	6·58	561,000	
June	13,780	9,530	11,750	7·34	8·19	699,000	
July	9,210	3,700	5,880	3·68	4·24	362,000	
August	3,600	2,400	2,900	1 81	2·09	78,300	
September	2,700	1,680	2,310	1·44	1·61	137,500	
October	1,780	1,440	1,615	1·01	1·16	99,300	
November	1,680	1,560	1,615	1·00	1·12	96,100	
December	1,540	1,030	1,260	0·79	0·91	77,500	
The period							30

NOTE.—The ice went out on February 28, 1912. Open to end of 1912. Accuracy, "A."

SILVER HOPE CREEK (120 AND 121.)

Silver Hope creek has its source in the mountains 15 miles south of Hope, at an elevation of from 2,000 to 3,000 feet, and discharges into Fraser river near Hope, at an elevation of 100 feet. It is part of the Fraser drainage. The drainage area, as measured from a Dominion sectional map, scale 3 miles to an inch, is 80 square miles. The precipitation varies from 50 inches, at the mouth, to 80 inches or more in the upper section of the watershed, where the winters are severe, with much snow. At present a very small amount of water from this creek is used for irrigation; there is some good land along the Fraser near the mouth of the creek, but with that exception there is little agricultural land in the Silver Hope valley, and none is taken up. The hillsides are very steep, which tends to give a rapid run-off, with small loss by evaporation and seepage. The creek is swift, with many rapids, but the fall is uniformly distributed through its whole length.

The creek is fairly well controlled by Silver lake, about 5 miles from the mouth, at an altitude of 1,100 feet. The lake has an area of 160 acres, and would afford a suitable reservoir for power development. Silver Hope creek is a poor power proposition, when compared with others in the same district still undeveloped.

Attempts have been made to build a railroad up the valley, but the grade was found to be too steep. The Pacific Highway, however, is now being built through the valley, and will give easy access to this district, which is unrivalled in its primitive beauty.

In establishing a gauging station on Silver Hope creek, it was found most convenient to locate the station at a point where an island divides the creek into two channels, necessitating the use of two gauges, one on each branch. The sum of the discharges of the two branches represents the total flow of Silver Hope creek. The station was established November 17, 1911, by C. G. Cline. It is located one-half mile from the mouth, and one-quarter mile above the C.N.R. bridge. Vertical staff gauges are located on both branches: on the left branch the gauge is fastened to the

left abutment of the highway bridge on the upstream side; on the right branch the gauge is fastened to a tree on the right bank 100 feet below the highway bridge. The measuring section on the right branch is 5 feet below the gauge; a tree was felled across the stream, and cable measurements are taken from it. The measuring section on the left branch is at the bridge during high water, when cable measurements are made; during lower water wading measurements are made 100 feet below the bridge.

DISCHARGE MEASUREMENTS of Silver Hope Creek, one-half mile from mouth, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
1911.	*Right Branch.*						
Dec. 11.....	K. H. Smith.....	1057	43	57·1	3·4	2·4	196
	Left Branch.						
Dec. 11.....	K. H. Smith.....	1057	49	52	3·4	1·0	177
1912.	*Right Branch.*						
Mar. 1...	C. G. Cline..	1046	35	74	1·9	1·90	147
June 7...	"	1046	38	127	6·0	3·50	765
Sept. 17.	"	1046	32	61	1·8	1·73	108
Nov. 19.	"	1048	40	134	4·9	3·35	652
Dec. 7...	"	1048	32	84	2·4	2·25	199
	Left Branch.						
Mar. 1.....	C. G. Cline.	1046	30	56	1·0	0·55	54·1
June 7.....	"	1046	41	82	4·1	1·70	335
Sept. 7.....	"	1046	34	30	0·8	0·50	25
Nov. 19.....	"	1048	41	65	3·4	1·65	216
Dec. 7.....	"	1048	39	37	1·2	0·48	43

NOTE.—Silver Hope creek was metered in two branches called right and left branch.

DAILY DISCHARGE of Silver Hope Creek, one-half mile from mouth, for 1911.

Day.	NOVEMBER.	DECEMBER.
	Discharge.	Discharge.
	Sec.-ft.	Sec.-ft.
1		304
2		293
3		274
4		274
5		255
6		255
7		255
8		371
19		476
10		409
11		359
12		347
13		304
14		274
15		274
16		255
17	335	238
18	1,750	222
19	1,261	222
20	1,003	214
21	753	207
22	558	255
23	436	384
24	359	304
25	409	255
26	576	238
27	436	222
28	359	207
29	314	185
30	293	178
31		178

MONTHLY DISCHARGE of Silver Hope Creek, one-half mile from mouth, for 1911.

(Drainage area, 80 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
			(estimated)				
November	1,750	293	500	6·3	7·0	29,750	
December	476	178	274	3·4	3·9	16,850	
The period							60

NOTE. These data are arrived at by summing the figures obtained from gaging stations on the right and the left branches of Silver Hope creek. These stations were not established till the middle of November, so that the totals obtained for the month of November are merely an approximation.

Accuracy, "A."

DAILY DISCHARGE of Silver Hope Creek, one-half mile from mouth, for 1912.

Day.	JANUARY.	FEBRUARY.	MARCH	APRIL.	MAY	JUNE.	JULY.	AUGUST.	SEPTEMBER	OCTOBER	NOVEMBER.	DECEMBER.
	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.	Discharge.
	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.
1	177	436	188	233	356	572	442	227	242	117	148	259
2	171	371	188	289	356	687	711	222	242	117	141	259
3	168	347	183	297	365	586	600	204	217	123	139	367
4	154	304	183	297	365	646	501	199	189	155	139	375
5	166	284	183	278	279	815	566	186	169	146	139	319
6	161	265	175	260	403	914	566	173	158	131	148	276
7	170	265	175	243	572	1,110	483	173	189	123	158	259
8	188	284	163	260	1,165	1,412	425	173	217	63	169	232
9	154	304	163	289	1,412	1,283	413	298	189	146	177	227
10	142	479	151	343	1,128	1,073	413	237	189	137	169	217
11	142	430	158	389	966	1,128	413	319	169	130	169	207
12	142	399	151	365	1,091	1,091	593	247	166	123	247	207
13	178	352	151	343	1,412	1,128	639	203	158	123	593	207
14	325	375	151	309	1,760	1,037	532	189	151	117	546	207
15	409	375	151	289	2,125	772	413	203	148	117	377	207
16	384	413	151	289	1,283	623	443	339	139	123	301	207
17	304	430	144	289	914	756	375	299	132	269	283	207
18	255	430	151	297	800	984	339	339	132	242	454	237
19	248	399	144	289	879	1,091	330	319	132	227	881	237
20	258	352	144	260	1,283	1,309	330	269	131	189	655	212
21	242	318	143	260	1,521	1,320	297	257	131	177	728	198
22	214	297	133	271	1,165	852	297	212	123	166	655	185
23	199	288	133	278	879	806	297	198	123	166	721	185
24	207	257	144	278	784	931	278	189	117	166	655	194
25	301	240	144	278	966	949	330	198	117	177	569	185
26	314	235	163	278	1,245	1,093	289	189	117	203	451	174
27	274	224	196	260	1,309	883	260	177	117	189	367	174
28	264	201	224	260	966	639	247	166	117	169	325	198
29	325	188	233	289	784	483	227	158	117	169	306	189
30	789		218	365	696	442	213	158	117	166	288	212
31	576		209		609		213	177		158		227

MONTHLY DISCHARGE of Silver Hope Creek, one-half mile from mouth, for 1912.

(Drainage area, 80 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAIN-FALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
January	789	142	257	3·2	3·7	15,800	
February	479	188	329	4·1	4·4	18,900	
March	233	133	167	2·1	2·4	10,270	
April	389	233	291	3·6	4·0	17,300	
May	2,125	356	966	12·1	13·9	59,400	
June	1,412	442	914	11·4	12·7	54,400	
July	744	213	396	4·9	5·6	24,350	
August	339	158	219	2·7	3·1	13,500	
September	242	117	154	1·9	2·1	9,160	
October	269	117	159	2·0	2·3	9,780	
November	881	139	369	4·6	5·1	21,860	
December	375	174	227	2·8	3·2	13,960	
The year	2,125	117	371	4·6	62·5	268,780	80

SILVER PITT CREEK (113).

Silver Pitt creek rises in the hills between Coquitlam lake and Pitt lake, at an elevation of about 3,000 feet, and flows from the west into Pitt river, near Pitt lake, at an elevation of 10 feet. It is part of the Pitt-Fraser drainage. About 3 miles from its mouth the stream flows out through a canyon to a flat where it has numerous branches, and frequently changes its channels. In the last mile of its course it forms a slough in which the water rises and falls with the water in Pitt river, under the influence of the tides.

The watershed is in the coast district, with a mean annual precipitation of about 80 inches. The stream does not freeze over near its mouth, but near the head-waters the winter conditions are more severe.

Coquitlam has applied for water for municipal supply, and New Westminster wants to develop power on the creek. Neither has made any use of the water as yet.

A gauging station was established on Silver Pitt creek on August 9, 1912, and gauge readings are being taken about three times a week. The station is at the lower end of the canyon and measures the whole flow of the stream. The gauge is a 6-foot vertical staff nailed to the upstream side of a 16-inch hemlock tree on the left bank of the stream. The meter measurements are made by wading at a section 5 feet above the gauge. There is a deep pool in the canyon above the station, and there are rapids below. One meter measurement has been taken at a low stage of the stream, giving a discharge of 249 cubic feet per second. During the season of 1913 sufficient meter measurements will be made to locate the rating curve.

SPILLIMACHEEN RIVER (418).

Spillimacheen river is the largest tributary of Upper Columbia river, entering from the west about 40 miles south of Golden. It drains an area of 580 square miles of the Selkirk mountains, in which the precipitation is fully 50 inches, principally snowfall. The mountains vary in height from 6,000 to 9,000 feet above sea-level.

The Spillimacheen flows mostly in a southeasterly direction, corroborating the theory that the Columbia once upon a time flowed southerly, connecting with Kootenay river via Canal Flat.

Spillimacheen river has three main forks. About 10 miles from the mouth it divides into the North and Middle fork, the latter being the larger. Fifteen miles farther up the Middle fork divides, the larger branch being called the South fork, having its source near the head-waters of Bugaboo river. About 3 or 4 miles above the mouth of the South fork, the Middle fork is joined by Copper creek from the south.

The North fork is about 45 miles long and runs almost parallel to, and only 4 miles from the Middle fork. It has its source at Grizzly Pass, near Bald mountain, in township 27-24-5. Its main tributaries are McMurdo creek from the south, in township 25-23-5, and Baird creek from the east in township 26-24-5.

The principal interest on Spillimacheen river is lumbering, the stream being used extensively for log-driving. There is also a little mining done on some small tributaries.

Spillimacheen river station is about 1 mile from its mouth, and 3 miles from Spillimacheen Landing. The gauge is located on the highway bridge leading from the Landing to the Giant mine. The gauge is a vertical staff, 6 feet long, graduated in feet and tenths. Bench-marks were established and referred to the zero of the gauge. The gauge is fastened to a pier of the bridge near the right bank. At the station the river is about 124 feet wide and nearly 6 feet deep at mean water level. The difference between high and low water level is about 3 feet. The mean velocity at high water is over 3 feet per second.

Below the bridge, the river flows through a flat covered with thick undergrowth and timber, and is affected by back water from the Columbia at high water. Just above the bridge the river runs through a canyon 1 mile long. The fall in the canyon is 185 feet (measured by aneroid). The banks are steep and of a broken rock formation, being 45 feet high at the foot of the canyon and 80 feet high at the head. At the foot of the canyon the river is 75 feet wide, and 40 feet wide at the head. A pipe-line power development is feasible; the pipe-line would be less than a mile long by making a short rock cut. By constructing a dam 50 feet high and from 40 to 60 feet long at the head of the canyon, a head of 230 feet could be obtained. There would be only small pondage. A good power-house site is available at the foot of the canyon. There are no good natural lakes or storage reservoirs. Severe winter conditions would have to be met. There is no market at present for this power.

The flood flow of Spillimacheen river is of importance and interest in connection with the possible reclamation of the overflow bottom lands of the Upper Columbia valley from Golden to lake Windermere.

DISCHARGE MEASUREMENTS of Spillimacheen River, near Spillimacheen Landing, 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 31	H. C. Hughes	1055	119	465	2·4	1·31	1,120
June 17	"	1055	122	585	4·7	2·20	2,740
June 19	"	1055	124	620	5·5	2·55	3,450
July 6	"	1055	122	570	4·8	2·25	2,750
July 17	"	1055	124	600	5·1	2·35	3,040
Sept. 29	"	1055	114	380	1·4	0·42	550

GAUGE HEIGHT AND DAILY DISCHARGE of Spillimacheen River, near Spillimacheen Landing, for 1912.

DAY.	JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		1,030	2·1	2,490		3,000	1·2	1,000	0·40	544
2		970		2,800	2·3	2,910		910		550
3	1·1	910	2·1	2,490		2,910	1·0	835		550
4		870		2,300	2·3	2,910		800	0·35	530
5	1·0	835	2·2	2,700		2,600		800		510
6		1,000		2,500	1·9	2,080	0·9	770	0·30	514
7	1·5	1,380		2,400	2·0	2,080		800		520
8	2·0	2,280	2·0	2,280		2,500	1·0	835	0·35	530
9		3,000		2,400	2·3	2,910		780		520
10		2,500	2·1	2,490		2,600	0·85	740		520
11		3,000	2·1	2,490	2·0	2,280		800	0·30	514
12		2,800		2,600		2,180		900		514
13		2,900	2·6	3,570	1·9	2,080	1·25	1,050	0·30	514
14		2,700	2·4	3,130		2,100		850		514
15		2,400	2·0	2,280		2,300	0·9	770	0·30	514
16		2,200		2,350	2·1	2,490		740		580
17	2·2	2,700		2,400		2,000	0·8	715		600
18		3,400	2·1	2,490	1·6	1,540		680	0·50	580
19	2·6	3,570		2,600		1,600		640		560
20	2·1	2,490	2·2	2,700		1,660	0·6	620	0·40	544
21	2·8	4,020	2·3	2,910	1·7	1,710		640		530
22	3·0	4,480		2,800		2,400	0·7	664	0·30	514
23		4,600	2·2	2,700	2·3	2,910		640		514
24	3·2	4,950		2,600		3,130	0·6	620		514
25		5,050		2,600	2·5	3,350		600	0·30	514
26	3·3	5,190	2·1	2,490		3,460		600		500
27	3·0	4,480	2·0	2,280	2·6	3,570	0·5	580	0·20	488
28	2·8	4,020	2·0	2,280		2,200		565		475
29	2·3	2,910		2,600	1·3	1,110	0·42	550	0·10	465
30		2,800	2·3	2,910	1·3	1,110		550		465
31				3,000		1,050			0·10	465

MONTHLY DISCHARGE of Spillimacheen River, near Spillimacheen Landing, 1912.
(Drainage area, 580 square miles.)

Month.	Discharge in Second-Feet.			Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	5,190	835	2,850	4·9	5·5	169,600	
July	3,570	2,280	2,600	4·5	5·2	159,900	
August	3,570	1,050	2,350	4·0	4·6	144,500	
September	1,050	550	735	1·3	1·45	43,700	
October	600	465	521	0·9	1·04	32,000	
The period							50

NOTE.—Gauging station established June 1, 1912. Freeze-up occurred November 1, 1912, and the station was abandoned for the season. The maximum discharge for 1912 occurred on June 26, and was 5,190 c.f.s. The maximum of an average year would be about 7,000 c.f.s. In 1894, the year of the famous flood, it probably attained 10,000 c.f.s. The river is frozen generally from the first week in November till about April 1. The minimum flow occurs about the latter part of February or early in March, and is estimated at 150 to 200 c.f.s. The gauge on Spillimacheen river was read only three times per week. In order to interpolate for the intervening days, a hydrograph of Bugaboo river was used as reference. These two rivers are adjacent and have very similar drainage areas.

SPIUS CREEK (212).

Spius creek has its source in mountains near township 11-23-6, at an elevation of 4,000 feet and, flowing due north for 25 miles, discharges into Nicola river near the Railway Belt boundary, at an elevation of 1,800 feet. It is part of the Nicola-Thompson drainage; the drainage area, as measured from a Dominion sectional map, scale 3 miles to an inch, is 344 square miles. The stream is used for both lumbering and irrigation. It is a stream varying from 25 to 100 feet in width, from 2 to 10 feet in depth, and has a mean velocity of from 1·5 to 5 feet per second. There is a very large freshet in May. The bed of the stream is generally rocky, and at times it passes through canyons and over small falls. The valley of the creek varies from one-quarter of a mile to one mile in width, and contains good agricultural land, for which irrigation is necessary, the precipitation not exceeding 20 inches, except very near the source. Considerable area of land is also taken up along Prospect creek, a large tributary entering from the west about 10 miles from the mouth. Several timber limits are held along Spius creek about 5 miles from the mouth, by the Nicola Valley Pine Lumber Co. This company established a mill 1 mile up the creek, and constructed a timber, rock-filled dam 40 feet high, which affords them a log pond of 25 acres. Logs are driven down the creek during the freshet in May and June.

The station on Spius creek was established August 15, 1911, by C. E. Richardson. The measuring section at low water is located 20 yards below the dam, and at high water one-half mile below the dam. A vertical staff gauge, 10 feet long, is located on the left bank of the stream, 200 yards below the dam. This station has been abandoned on account of the control of the Nicola Valley Pine Lumber Co.'s dam above the gauge and a new diversion dam just below the gauge. A new station will be established above the company's dam.

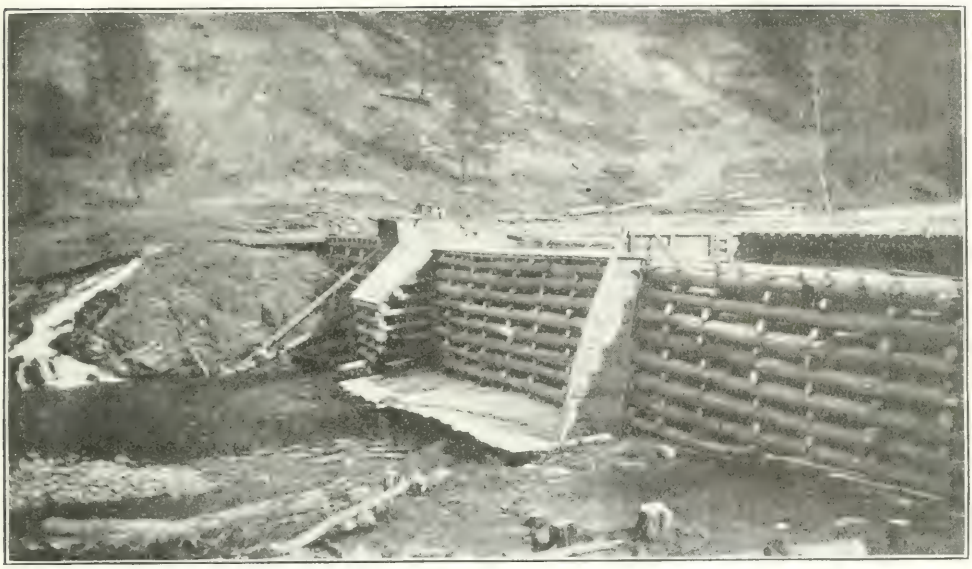
DISCHARGE MEASUREMENTS of Spius Creek, below dam, 1911-12.

Date.	Hydrographer.	Meter No.	Width	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
1911.							
Aug. 15	C. E. Richardson	1048	38	52·	3·5	0·87	130
Sept. 18	"	1048	56	60	2·6	0·92	156
1912.							
June 22	Cline & Corbould	1046	62	193	2·5	2·90	480
July 6	B. Corbould	1044	98	134	1·6	2·30	217
July 24	"	1044	27	36·5	2·6	1·75	96
Aug. 14	"	1044	28	28·	2·0	1·50	57

NOTE.— 1911, gauge No. 1; 1912, gauge No. 2.

DAILY GAUGE HEIGHT AND DISCHARGE of Spius Creek, below dam, for 1911.

Day.	August.		September.		October.		November.	
	Gauge height.	Discharge	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·7	75	0·8	105	0·7	75
2			0·7	75	0·8	105	0·7	75
3			0·7	75	0·8	105	0·7	75
4			0·7	75	0·8	105	0·7	75
5			0·7	75	0·8	105	0·7	75
6			0·8	105	0·8	105	0·7	75
7			0·8	105	0·8	105	0·7	75
8			0·7	75	0·8	105	0·7	75
9			0·7	75	0·8	105	0·7	75
10			0·7	75	0·8	105	0·7	75
11			0·7	75	0·8	105	0·7	75
12			0·7	75	0·8	105	0·7	75
13			0·8	105	0·8	105	0·7	75
14			1·1	250	0·8	105	0·7	75
15			1·07	235	0·8	105	0·7	75
16			1·05	225	0·8	105	0·7	75
17			1·0	200	0·8	105	0·8	105
18	0·8	105	0·95	175	0·8	105	0·8	105
19	0·8	105	0·9	150	0·8	105	0·8	105
20	0·8	105	0·9	150	0·8	105	0·8	105
21	0·8	105	0·9	150	0·75	90	0·8	105
22	0·8	105	0·9	150	0·75	90	0·8	105
23	0·8	105	0·9	150	0·75	90		
24	0·8	105	0·9	150	0·72	81		
25	0·8	105	0·87	136	0·7	75		
26	0·8	105	0·85	128	0·7	75		
27	0·8	105	0·82	114	0·7	75		
28	0·7	75	0·8	105	0·7	75		
29	0·7	75	0·8	105		75		
30	0·7	75	0·8	105	0·7	75		
31	0·7	75			0·7	75		



Lumber Company's Dam on Spius Creek.

Lumber Company's Dam on Spius Creek.

MONTHLY DISCHARGE of Spius Creek, below dam, for 1911.

(Drainage area, 270 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAIN-FALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
September	250	75	125	·46	·51	7,440	
October	105	75	96	·36	·42	5,900	
November	105	75	83	·31	·35	4,940	
The period							15

NOTE.—Station was established August 18, 1911.
Accuracy, "C."

GAUGE HEIGHTS AND DAILY DISCHARGE of Spius Creek, below dam, for 1912.

Day.	MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			2·9	480		250	1·5	60		60
2				455		250	1·5	60	1·5	60
3			2·8	430		250	1·5	60	1·5	60
4			2·8	430	2·4	250		60	1·5	60
5			3·1	590	2·4	250	1·5	60	1·5	60
6			3·0	535	2·4	250	1·5	60	1·5	60
7			3·0	535	2·3	215		60		60
8	3·5	820	3·3	700	2·0	130		60		60
9	4·0	1,130		620	2·0	130	1·5	60	1·5	60
10	3·6	880	3·0	535	2·1	155	1·5	60	1·6	70
11	3·5	820	3·0	535	2·1	155		60	1 6	70
12	3·8	1,000	3·1	590	2·1	155	1·5	60	1·6	70
13	4 2	1,270	3 0	535	2·1	155	1·5	60		
14	4·5	1,480	2·8	430		170	1·5	60		
15	4·2	1,270	2·6	335	2·2	185	1·5	60		
16	3·8	1,000		360	2·1	155	1 8	95		
17	3·4	760	2·7	380	2·1	155	2·0	130		
18	3·2	645	2·6	335	2·0	130	2·0	130		
19	3·2	645		360		110	1·8	95		
20		700		385		90	1·7	80		
21		760		410		70	1·6	70		
22	3·5	820	2·8	430	1·4	50	1·5	60		
23	3·3	700		360	1·5	60	1·5	60		
24		715	2·5	290	1·7	80	1·5	60		
25		730	2·7	380	1·8	95		60		
26		745	2·7	380	1·8	95	1·5	60		
27	3·4	760	2·6	335	1·55	65	1·5	60		
28	3·0	535	2·4	250		80	1·5	60		
29	3·0	535		250	1·8	95	1·5	60		
30	3·0	535		250	1·5	60	1·5	60		
31	3·0	535			1·5	60	1·5	60		

SESSIONAL PAPER No. 25f

MONTHLY DISCHARGE of Spius Creek, below dam, for 1912.

(Drainage area, 270 square miles.)

Month.	DISCHARGE IN SECOND FEET.				RUN OFF.		RAINFALL.
	Maximum	Minimum	Mean	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May.....	1,480	535	825	3·1	3·6	50,700	
June.....	700	250	430	1·6	1·2	25,600	
July.....	250	50	142	·53	·61	8,730	
August..	130	60	67·7	·25	·29	4,160	
The period.							15

STEIN CREEK (131).

Stein creek has its source in the mountains surrounding mount Stein, at an elevation of 5,000 feet and, flowing in an easterly direction for a distance of 30 miles, discharges into Fraser river near Lytton, at an elevation of 500 feet. It is part of the Fraser drainage; the drainage area, as measured from a Dominion sectional map, scale 3 miles to an inch, is 130 square miles. The precipitation at the mouth is small (not exceeding 20 inches) but at the source on the eastern mountains of the coast range the precipitation (both rain and snow) is heavy, from 50 to 70 inches. The maximum discharge in 1912 amounted to 3,000 second-feet on June 30; the minimum flow was 80 second-feet on the 10th of March.

The stream generally is about 50 feet wide, from 2 feet to 10 feet deep, and varying in velocity from 1½ feet per second to 8 feet per second. The valley is rough and broken, covered with underbrush and scattered timber. The stream is fast and turbulent, rushing in and out of canyons, and over rapids and falls. The drop in the last 20 miles of the river is at the rate of 150 feet per mile. No agricultural land is to be found in the valley, at least not within 20 miles of the mouth. Above this 20-mile post the formation somewhat changes. It is claimed that for 2 or 3 miles the river is navigable for small craft. Through this district the hunting is excellent and the fishing unexcelled. Stein creek was prospected years ago, and a trail still runs practically to the source, but it presents great difficulties to travellers.

Stein creek is used at the present time for irrigation purposes. Records to the extent of 1,000 inches are taken out, appurtenant to lands in the vicinity along the valley of the Fraser.

The C.P.R. investigated Stein creek regarding water-power possibilities, but decided on nothing. The chief objection to any power development on Stein creek is the lack of good storage. Good summer power may be obtained.

The hydrographic station on Stein creek was established on September 22, 1911, by C. E. Richardson, and continuous readings have since been taken during the open season. The measuring section is located on the downstream side of the highway bridge, about half a mile from the mouth, and 3 miles from the Fraser river ferry above Lytton. All measurements are made by suspending the meter from a cable. A standard vertical staff gauge is fastened to the cribbing of the right abutment, on the downstream side. In the spring of 1912 a chain gauge was established for use during high water; the datum of both gauges is the same, and is referred to three bench-marks. This is a fair section, excellent control, high banks, and one permanent channel; but the channel bed is very rocky, and accurate soundings are difficult.

DISCHARGE MEASUREMENTS of Stein Creek, near mouth, 1911-12.

Date	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Sept. 22.....	C. E. Richardson.	1,048	57	203	3·4	0·60	684
1912.							
Mar. 27.....	C. G. Cline	1,046	38	121	1·3	*1·00	152
May 30.....	"	1,046	55	279	4·9	1·75	1,360
July 26.....	"	1,046	50	250	4·8	1·70	1,190

*One foot below gauge datum.

GAUGE HEIGHTS AND DAILY DISCHARGE of Stein Creek, near mouth, for 1911.

Day.	SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1				440		255		245
2				425		255	−0·6	240
3				410	−0·54	255		240
4				395		230		240
5				385		210		240
6				375		190		240
7			−0·17	366		170		240
8				360		150		240
9				350		130		240
10				340	−1·33	101	−0·6	240
11				335		115		230
12				330		130		220
13				320		145		210
14			−0·34	313		160		200
15				310		170		190
16				307		180		180
17				304		190	−0·92	166
18				301		200		175
19				300		205		185
20				297		210		195
21			−0·4	295		220		205
22	0·6	685		290		230		215
23				285		235	−0·66	225
24				280		240		225
25				275		255		225
26				270	−0·5	265		225
27			−0·5	265		265		220
28				265		265		220
29	0·1	470		260		260		220
30				260		260		220
31				260				220

MONTHLY DISCHARGE of Stein Creek, near mouth, for 1911.

(Drainage area, 130 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
October	440	260	322	2·5	2·9	19,800	
November	265	101	204	1·6	1·8	12,100	
December	245	166	219	1·7	2·0	13·500	

NOTE.—Station established Sept. 22, 1911.
Accuracy, "C."

GAUGE HEIGHTS AND DAILY DISCHARGE

DAY.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		220		215	−1·4	92		200		650
2		220		215		90		210		660
3		220		215		88		220		670
4		220		215		86		230		680
5		220		215		86	−0·6	240	0·6	685
6		220		215		86		265		900
7		215		215		84		290		1,100
8		215		215		82		315		1,300
9		215		215		82		340		1,500
10		215	−0·7	215	−1·5	80		365		1,700
11		215		215		80	−0·1	390		1,900
12		215		215		80		420	3·0	2,100
13		215		215		90		450		2,020
14	−0·7	215		215		90		480		1,950
15		215		215		100		520		1,880
16		215	−0·7	215		100		550		1,800
17		215		210		100		580		1,720
18		215		200		110		620		1,640
19		215		180		110		650	2·2	1,560
20		215		180		120	0·6	685		1,560
21		215		170		120	0·6	685		1,570
22		215		160		130		680		1,580
23		215	−0·1	150		130		670		1,590
24		215		140		130		660		1,600
25		215		130		140		650		1,610
26		215		120		140		640	2·3	1,620
27		215		110	−1·0	150		630		1,585
28		215		105		160	0·5	635		1,550
29		215		100		175		640		1,515
30		215			−0·8	190		645		1,480
31		215				200				1,445

of Stein Creek, near mouth, for 1912.

June.		July.		August.		September.		October.		November.		Day.
Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
	1,405		2,860		1,330	0·5	635		440		335	1
	1,370		2,720		1,345		620		450		330	2
	1,335		2,580		1,360		610		460	−0·3	325	3
	1,300		2,440	1·9	1,380		600		480		325	4
1·7	1,265		2,300		1,415		590		495		320	2
	1,490		2,160		1,450		580	0·2	510		315	6
	1,715		2,020		1,485		565		475		310	7
	1,940		1,880		1,520	0·3	550		450		305	8
3·1	2,180		1,740		1,555		575		425		300	9
	2,200		1,600		1,590		600		400	−0·4	295	10
	2,225		1,460	2·3	1,620		625		375		310	11
	2,250	1·8	1,320		1,600		650		350		325	12
	2,275		1,360	.....	1,580		675	0·3	325		340	13
	2,300		1,400	.....	1,560		700		325		355	14
	2,320		1,440	.....	1,540	0·7	730		330		360	15
3·3	2,340	.....	1,480		1,520		700		325		375	16
	2,395		1,520		1,510		675		330	−0·1	390	17
	2,450		1,560	2·1	1,500		650		345		400	18
	2,500		1,600		1,490		625		350		415	19
	2,550		1,640		1,480		600	−0·2	355		430	20
	2,600	2·4	1,680		1,470		575		355		440	21
3·7	2,660		1,620		1,460	0·3	550		355		450	22
	2,700		1,560		1,450		530		355		460	23
.....	2,750		1,500	.....	1,445		510		355	0·1	470	24
	2,800		1,440	2·0	1,440		490		355		470	25
	2,840		1,380	.....	1,300		470		355		470	26
	2,880		1,320	.....	1,170		450	−0·2	355		470	27
	2,920	1·7	1,265	.....	1,040		440		355		470	28
	2,960		1,280	.....	910	0·0	430		350		470	29
4·0	3,300		1,295	.....	780		430		345		470	30
			1,315		700				340			31

Monthly Discharge of Stein Creek, near mouth, for 1912.

(Drainage area, 130 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean	Per sq. mile	Depth in inches on Drainage area	Total in acre-feet.	Inches.
January	220	215	216	1·7	2·0	13,300	
February	215	160	186	1·4	1·5	10,700	
March	200	80	113	0·9	1·0	6,900	
April	685	200	485	3·7	4·1	28,900	
May	2,100	650	1,455	11·2	12·9	89,400	
June	3,000	1,405	2,264	17·4	19·4	135,000	
July	2,860	1,265	1,701	13·1	15·1	105,000	
August	1,520	700	1,387	10·7	12·3	85,200	
September	730	430	581	4·5	5·0	34,600	
October	510	325	383	2·9	3·3	23,600	
November	470	295	383	2·9	3·2	22,800	

Note.—During January and February stream partly frozen over.
Accuracy, "C."

Sullivan Creek (242).

Sullivan creek has its source in Knouff lakes, at a probable elevation of 3,000 feet, and discharges into North Thompson river from the east, 20 miles north of Kamloops. It is part of the North Thompson drainage; the drainage area, as measured from the Geological Survey map, dated 1895, scale 2 miles to an inch, is 17 square miles. Sullivan creek is a small irrigation stream; its upper reaches are on the easterly edge of the Dry Belt, where the annual precipitation may sometimes reach 25 inches. At the mouth, in the most arid portion of the Dry Belt, the mean annual precipitation is about 10 inches.

Sullivan creek is about 8 miles long, 4 feet wide, and varies from a few inches to one foot in depth. Knouff lakes, the source of the creek, afford good storage for irrigation water. For the first 3 miles the creek descends at the rate of 300 feet to the mile, when it reaches the Sullivan valley at an elevation of about 2,000 feet. Several good farms are located in the valley, which is 12 square miles in area, is sparsely settled, and affords excellent range land. From this point to the mouth the stream falls rapidly; there is much loss from seepage, the creek often being dry at the mouth while running in the Sullivan valley. The prior record is appurtenant to land in the North Thompson valley, but, to utilize the water, fluming or piping would be necessary. Water is diverted from Edwards creek, which rises in the vicinity of the Knouff lakes, and is applied to land in the Sullivan valley.

The station on Sullivan creek was established August 21, 1911, by C. G. Cline. The measuring section is located about 30 feet below the Sullivan diversion dam, near the Sullivan valley road, at Edwards' ranch. It is a good section; the control is good, current uniform, banks not liable to overflow, and one permanent channel. All the measurements are made by wading; they might be affected by the rising and sinking of the stream, which occurs frequently. A standard vertical staff gauge is located on the right bank 7 feet above Cameron's private bridge. The datum of the gauge is referred to three bench-marks.

Discharge Measurements of Sullivan Creek, above diversions, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
Aug. 21	C. G. Cline	1046	3·5	1·7	0·3	1·51	0·4
1912.							
May 2	Cline and Dann	1046	8·0	6·3	0·8	2·10	5·3
May 31	E. M. Dann		4·0	2·0	1·6	1·93	3·2*
Aug. 19	H. J. Keyes	1057	7·7	4·2	0·7	1·90	3·0

*Float measurement.

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DAILY GAUGE HEIGHT AND DISCHARGE of Sullivan Creek, above diversions, for 1911.

Day.	August.		September.		October.		November.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
1			1·5	0·4	1·45	0·3	1·5	0·4
2			1·5	0·4	1·45	0·3	1·5	0·4
3			1·5	0·4	1·45	0·3	1·5	0·4
4			1·5	0·4	1·45	0·3	1·5	0·4
5			1·5	0·4	1·45	0·3		
6			1·5	0·4	1·45	0·3		
7			1·5	0·4	1·45	0·3		
8			1·5	0·4	1·45	0·3		
9			1·5	0·4	1·45	0·3		
10			1·45	0·3	1·45	0·3		
11			1·45	0·3	1·45	0·3		
12			1·45	0·3	1·45	0·3		
13			1·5	0·4	1·45	0·3		
14			1·5	0·4	1·45	0·3		
15			1·5	0·4	1·45	0·3		
16			1·5	0·4	1·5	0·4		
17			1·5	0·4	1·5	0·4		
18			1·5	0·4	1·5	0·4		
19			1·5	0·4	1·5	0·4		
20			1·5	0·4	1·5	0·4		
21	1·5	0·4	1·5	0·4	1·5	0·4		
22	1·5	0·4	1·45	0·3	1·5	0·4		
23	1·5	0·4	1·45	0·3	1·5	0·4		
24	1·5	0·4	1·45	0·3	1·5	0·4		
25	1·5	0·4	1·45	0·3	1·5	0·4		
26	1·5	0·4	1·45	0·3	1·5	0·4		
27	1·5	0·4	1·45	0·3	1·5	0·4		
28	1·5	0·4	1·45	0·3	1·5	0·4		
29	1·5	0·4	1·45	0·3	1·5	0·4		
30	1·5	0·4	1·45	0·3	1·5	0·4		
31	1·5	0·4			1·5	0·4		

MONTHLY DISCHARGE of Sullivan Creek, above diversions, for 1911.

(Drainage area, 17 square miles.)

Month.	Discharge in Second Feet.			Run Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
September	0·4	0·3	0·36	·02	·02	21	
October	0·4	0·3	0·35	·02	·02	21	
The period							10

NOTE.—This station was established on August 21 1911. There is a dam at the outlet of the lower Knouff lake which regulates to some extent the flow of Sullivan creek.

Accuracy, "A."

DAILY GAUGE HEIGHT AND DISCHARGE of Sullivan Creek, above diversions, for 1912.

Day.	MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.	
	Gauge height	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	5·3	1·8	2·0	2·0	4·1	1·7	1·2	1·8	2·0
2	2·1	5·3	1·8	2·0	2·0	4·1	1·65	1·0	1·85	2·5
3	2·1	5·3	1·8	2·0	2·0	4·1	1·6	0·7	1·85	2·5
4	2·1	5·3	1·8	2·0	2·0	4·1	1·6	0·7	1·8	2·0
5	2·1	5·3	1·8	2·0	2·0	4·1	1·7	1·2	1·8	2·0
6	2·1	5·3	1·8	2·0	2·0	4·1	1·9	2·9	1·8	2·0
7	2·1	5·3	1·8	2·0	2·0	4·1	1·9	2·9	1·9	2·9
8	2·1	5·3	1·8	2·0	2·0	4·1	1·9	2·9	1·85	3·0
9	2·1	5·3	1·8	2·0	1·9	2·9	1·9	2·9	1·8	2·0
10	2·1	5·3	2·1	5·3	1·9	2·9	1·9	2·9	1·8	2·0
11	2·1	5·3	2·2	6·5	1·9	2·9	1·9	2·9	1·8	2·0
12	2·2	6·5	2·3	7·8	1·9	2·9	1·9	2·9	1·8	2·0
13	2·1	5·3	2·2	6·5	1·9	2·9	1·9	2·9	1·7	1·2
14	2·1	5·3	2·3	7·8	1·9	2·9	1·9	2·9	1·7	1·2
15	2·1	5·3	2·3	7·8	1·8	2·0	1·9	2·9	1·7	1·2
16	2·1	5·3	2·3	7·8	1·8	2·0	1·9	2·9	.....	.....
17	2·1	5·3	2·3	7·8	1·8	2·0	1·9	2·9	.....	.....
18	2·1	5·3	2·3	7·8	1·8	2·0	1·9	2·9	.....	.....
19	2·1	5·3	2·2	6·5	1·8	2·0	1·9	2·9	.....	.....
20	2·1	5·3	2·2	6·5	1·8	2·0	1·9	2·9	.....	.....
21	2·0	4·1	2·2	6·5	1·8	2·0	1·9	2·9	.....	.....
22	2·0	4·1	2·2	6·5	2·0	4·1	1·8	2·0	.....	.....
23	2·0	4·1	2·1	5·3	2·0	4·1	1·8	2·0	.....	.....
24	2·0	4·1	2·1	5·3	1·8	2·0	1·8	2·0	.....	.....
25	2·0	4·1	2·0	4·1	1·75	1·6	1·8	2·0	.....	.....
26	2·0	4·1	2·0	4·1	1·7	1·2	1·8	2·0	.....	.....
27	2·0	4·1	2·1	5·3	1·7	1·2	1·8	2·0	.....	.....
28	2 0	4 1	2·1	5·3	1·7	1·2	1·8	2·0	.....	.....
29	1·9	2·9	2·1	5·3	1·7	1·2	1·8	2·0	.....	.....
30	1·9	2·9	2·0	4·1	1 7	1·2	1·8	2·0	.....	.....
31	1·9	2·9	.....	.....	1·7	1·2	1·8	2·0	.....	.....

MONTHLY DISCHARGE of Sullivan Creek, above diversions, for 1912.
(Drainage area, 17 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	6·5	2·9	4·8	·30	·35	295	
June	7·8	2·0	4·9	·29	·32	292	
July	4·1	1·2	2·7	·16	·18	166	
August	2·9	0·7	2·3	·13	·15	141	
September	3·0	1·2	(estimated) 1·7	·10	·11	101	
The period	.....	.....	.....	.....	.....	.....	10

NOTE.—The flow of Sullivan creek is regulated to some extent by a dam on lower Knouff lake. Accuracy, "A."

SWELTZER CREEK (111).

Sweltzer creek rises in Cultus lake, at an elevation of 200 feet, and discharges into Chilliwack river at an elevation of 100 feet. It is part of the Chilliwack-Fraser drainage. Its watershed area is 35 square miles. The Indians use a little of the water for domestic purposes on the reserve and there is no immediate prospect of any other use of it. There is good fishing in Sweltzer creek and in Cultus lake. The stream is in the Coast district, with a mean annual precipitation of from 60 to 70 inches. There

is a considerable snowfall during the winter on the higher parts of the watershed. The stream does not freeze over near the mouth. The country is rough, and there are mountains in the vicinity. There is some timber on the hills. Surveys have recently been made around Cultus lake, and there is some land open for settlement.

The gauging station on Sweltzer creek is about a quarter of a mile from the mouth of the creek. It is three-quarters of a mile from the Vedder River hotel, which is 6 miles north of Sardis, a station near Chilliwack on the electric railway from New Westminster. The gauge is a 5-foot staff nailed to a large alder tree about 50 feet above the ford on the Cultus lake road, on the left bank of the stream, among the trees, and is referred to three bench-marks. Meter measurements are made by wading at a section 30 feet below the gauge.

Regular gauge readings were taken three times a week continuously from November 14, 1911, to November 11, 1912. They were discontinued because it was considered that one year's measurement would be sufficient on this unimportant stream.

DISCHARGE MEASUREMENTS of Sweltzer Creek, near mouth, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Nov. 14	K. H. Smith	1057	50	34	2·2	1·25	75
Dec. 8	"	1057	55	62	2·6	1·60	162
1912.							
Mar. 22	C. G. Cline	1046	48	41	1·9	1·38	79
July 6	"	1046	50	32	1·7	1·30	55
Sept. 1	"	1046	50	31	1·4	1·20	43

GAUGE HEIGHTS AND DAILY DISCHARGE of Sweltzer Creek, near mouth, for 1911.

Day.	November.		December.	
	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			1·7	216
2				216
3			1·7	216
4				230
5			1·75	245
6				218
7				190
8			1·6	162
9				175
10			1·65	189
11				175
12			1·6	162
13				162
14	1·25	50	1·6	162
15		50	1·55	139
16	1·25	50		128
17		106	1·5	116
18	1·6	162		116
19		218	1·5	116
20	1·8	274		116
21		260	1·5	116
22	1·75	245		128
23		230	1·55	139
24	1·70	216		139
25		230	1·55	139
26	1·75	245	1·5	116
27		230		116
28	1·7	216		116
29		216	1·5	116
30		216		107
31			1·45	98

GAUGE HEIGHTS AND DAILY DISCHARGE

Day.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	height.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	98	1·7	216	.....	116	1·4	81	1·3	58
2	1·45	98	.....	216	1·5	116	.....	81	.....	58
3	.....	98	1·7	216	.....	116	1·4	81	1·3	58
4	1·45	98	.....	189	1·5	116	.....	81	.....	58
5	.....	98	1·6	162	.....	116	1·4	81	1·3	58
6	1·45	98	.....	162	1·5	116	.....	81	.....	70
7	.....	90	1·6	162	.....	116	1·4	81	1·4	81
8	1·4	81	.....	189	1·5	116	.....	81	.....	81
9	.....	81	1·7	216	.....	98	1·4	81	1·4	81
10	1·4	81	.....	189	1·4	81	.....	81	.....	81
11	.....	81	1·6	162	.....	81	1·4	81	1·4	81
12	1·4	81	.....	162	1·4	81	.....	81	.....	81
13	.....	90	1·6	162	.....	81	1·4	81	1·4	81
14	1·45	98	.....	189	1·4	81	.....	81	.....	81
15	1·45	98	1·7	216	.....	81	1·4	81	1·4	81
16	.....	104	.....	216	1·4	81	.....	81	.....	81
17	.....	110	1·7	216	.....	81	1·4	81	1·4	81
18	1·5	116	.....	189	1·4	81	.....	81	.....	81
19	.....	116	1·6	162	.....	81	1·4	81	1·4	81
20	1·5	116	.....	162	1·4	81	.....	81	.....	81
21	.....	116	1·6	162	.....	81	1·4	81	1·4	81
22	1·5	116	.....	162	1·4	81	.....	81	.....	81
23	.....	139	1·6	162	.....	81	1·4	81	1·4	81
24	1·6	162	.....	162	1·4	81	.....	81	.....	81
25	.....	162	1·6	162	.....	81	1·4	81	1·4	81
26	1·6	162	.....	139	1·4	8	.....	81	.....	98
27	.....	162	1·5	116	.....	81	1·4	81	1·5	116
28	1·6	162	.....	116	1·4	81	.....	81	.....	116
29	.....	189	1·5	116	.....	81	1·4	81	1·5	116
30	1·7	216	.....	.....	1·4	81	.....	70	.....	116
31	.....	216	.....	.....	.....	81	.....	.....	1·5	116

of Sweltzer Creek, near mouth, for 1912.

June.		July.		August.		September.		October.		November.		Day.
Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	
Feet.	Sec.-ft	Feet.	Sec.-ft.	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	Feet.	Sec.-ft	
.....	116	1·	81	1·2	43	.....	43	.....	43	1·3	58	 1
1·5	116	1·4	81	.....	43	1·2	43	1·2	43	.....	58	 2
.....	98	.....	70	1·2	43	.....	43	.....	43	1·3	58	 3
1·4	81	1·3	58	.....	43	1·2	43	1·2	43	.....	58	 4
.....	81	.....	58	1·2	43	.....	43	.....	43	1·3	58	 5
1·4	81	1·3	58	.....	43	1·2	43	1·2	43	.....	58	 6
.....	81	.....	58	1·2	43	.....	43	.....	43	1·3	58	 7
1·4	81	1·3	58	.....	43	1·2	43	1·2	43	.....	58	 8
.....	81	.....	58	1·2	43	.....	43	.....	43	1·3	58	 9
1·4	81	1·3	58	.....	43	1·2	43	1·2	43	.....	58	10
.....	81	.....	58	1·2	43	.....	43	.....	43	1·3	58	11
1·4	81	1·3	58	.....	43	1·2	43	1·2	43	.....	.....	12
.....	81	.....	58	1·2	43	.....	43	.....	43	.....	.....	13
1·4	81	1·3	58	.....	50	1·2	43	1·2	43	.....	.....	14
.....	81	.....	58	1·3	58	.....	43	.....	43	.....	.....	15
1·4	81	1·3	58	.....	58	1·2	43	1·2	43	.....	.....	16
.....	81	.....	58	1·3	58	.....	43	.....	43	.....	.....	17
1·4	81	1·3	58	.....	58	1·2	43	1·2	43	.....	.....	18
.....	98	.....	58	1·3	58	.....	43	.....	43	.....	.....	19
1·5	116	1·3	58	.....	58	1·2	43	1·2	43	.....	.....	20
.....	98	.....	58	1·3	58	.....	43	.....	43	.....	.....	21
1·4	81	1·3	58	.....	58	1·2	43	1·2	43	.....	.....	22
.....	81	.....	58	1·3	58	.....	43	.....	43	.....	.....	23
1·4	81	1·3	58	.....	50	1·2	43	1·2	43	.....	.....	24
.....	81	.....	58	1·2	43	.....	43	.....	50	.....	.....	25
1·4	81	1·3	58	.....	43	1·2	43	1·3	58	.....	.....	26
.....	81	.....	50	1·2	43	.....	43	.....	58	.....	.....	27
1·4	81	1·2	43	.....	43	1·2	43	1·3	58	.....	.....	28
.....	81	.....	43	1·2	43	.....	43	.....	58	.....	.....	29
1·4	81	1·2	43	.....	43	1·2	43	1·3	58	.....	.....	30
.....	.....	.....	43	1·2	43	.....	.....	.....	58	.....	.....	31

Monthly Discharge of Sweltzer Creek, near mouth, for 1912.

(Drainage Area, 30 square miles.)

Month.	Discharge in Second-Feet.			Run-Off.			Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
January....	216	81	120	4·0	4·6	7,380	
February....	216	116	174	5·8	6·2	10,000	
March.....	116	81	91	3·0	3·5	5,600	
April.....	81	70	81	2·7	3·0	4,820	
May.....	116	58	83	2·8	3·2	5,100	
June ...	116	81	86	2·9	3·2	5,120	
July.....	81	43	58	1·9	2·2	3,570	
August.....	58	43	48	1·6	1·8	2,950	
September.	43	43	43	1·4	1·6	2,560	
October....	58	43	46	1·5	1·7	2,830	
The period.							50

Accuracy, "B."

THOMPSON RIVER (201-204).

Thompson river is the third largest river in British Columbia, being only exceeded by Fraser and Columbia rivers. It discharges into Fraser river at Lytton, 150 miles from the coast. The drainage area of the Thompson is 21,800 square miles, and may be divided into three divisions: The North Thompson drainage of 7,400 square miles, the South Thompson drainage of 7,000 square miles and the drainage of Thompson river from Kamloops to Lytton, of 7,400 square miles.

(1) The North Thompson rises at an elevation of 4,000 to 6,000 feet, about 10 miles south of Tete-Jaune Cache. It might be noted here that within a radius of 5 miles may be found the source of the Fraser, the Canoe (a tributary of Columbia river) and the North Thompson, the three streams which drain practically the whole of the south half of British Columbia. From its source the North Thompson flows south to Kamloops, where it joins South Thompson river. The valley of the North Thompson is being opened up by the Canadian Northern Pacific railway, which follows the river from Tete Jaune Cache to Kamloops.

The mineral wealth of the country in this drainage is still unknown. Mica exists in large quantities in the upper valley, above Mad river. Gold has been found in various tributaries and, at the present time, a mine is being worked on Louis creek, about 30 miles north of Kamloops, which, if it turns out well, will be a big asset to the surrounding country. Water-power may be developed on the river itself at Hells Gate, 160 miles up. A head of 30 feet may be obtained, and a minimum flow of 300 to 500 second-feet. Of the tributaries, Barrier river, at the 35-mile post, is the most important. A plant is now being installed whereby the city of Kamloops will obtain its light and power from the Barrier. Good industrial powers of from 1,000 to 2,000 horse-power may be located on the following streams: (1) Mad river, at the 97-mile post. (2) Tum Tum creek, at the 112-mile post. (3) Salmon or Porcupine creek, at the 136-mile post. (4) Hell Roaring creek, at the 152-mile post. (5) Pyramid creek, at the 162-mile post. All these streams become very small in the winter and very little continuous power could be obtained.

From Tete Jaune Cache to Kamloops, by the river, is about 250 miles, but by the C.N.R. it is less than 190. (All mile posts are located by the C.N.R.) From Kamloops to Mad river, at the 97-mile post, the valley varies from one-half mile to 1 mile in width, the soil is a sandy loam and first-class land for fruit and mixed farming. Above Mad river the valley becomes much narrower, and there are only about 16,000 acres of arable land. Irrigation is required up to the 100-mile post, the precipitation varying from 7 inches to 13 inches at Kamloops, to 40 inches at the Albreda summit. Practically all the land has been taken up in the valley, the few unsettled bits, here and there, being very poor land.

There is no large timber in the valley except near the source, where several limits are held.

The streams and rivers above the 97-mile post are devoid of fish, said to be due to the large amount of mica in the water; and apart from a few bear there is no game to speak of in the valley.

The station on the North Thompson (203) was established by C. G. Cline on February 13, 1912, at Cooney's ranch, 2 miles above the Hefferly riffle, and 18 miles north of the city of Kamloops. It is a quarter of a mile above the mouth of Jamieson creek. The gauge is a chain gauge, whose total length is 35 feet, suspended from a pulley on the end of a small tree trunk nailed to two trees, and projecting over the stream. Measurements are made from a row boat steadied by a cable, which is stretched across the stream for each metering; owing to the stream being navigable it is not practicable to leave the cable permanently in place. The banks are from 25 to 50 feet high and the river is in one channel, whose depth is about 20 feet in low

water, and whose width is about 400 feet. The range of gauge heights from low to high water is from 10 to 15 feet.

The bench-marks to which the chain gauge is referred, are as follows:—

B.M. No. 1.—Nail in top of 8-inch poplar stump, 24 feet north of the gauge and 12 feet from the edge of the river at low water. Its elevation is 20·67 feet.

B.M. No. 2.—Nail in top of 6-inch poplar stump, 20 feet north of the gauge and 24 feet from the edge of the river at low water. Elevation 27·50 feet.

B.M. No. 3.—Nail in top of 8-inch poplar stump, 72 feet north of the gauge and 20 feet from low water line. Elevation, 27·35 feet.

The maximum discharge of the North Thompson in 1912 was about 40,000 second-feet in June, and the minimum flow was 1,600 second-feet, and occurred in March. Sufficient measurements have not been obtained to compute the daily discharges.

The North Thompson river is navigable during the summer from Kamloops to the 92-mile post, from the 112 to the 125-mile post and from the 137 to the 172-mile post.

(2) *South Thompson River.*—The North and South Thompson meet at Kamloops (Chinook for 'Meeting of the waters'). The South Thompson rises in Shuswap lake, and is only a flowing stream between Chase and Kamloops, a distance of 40 miles. It is very sluggish, the fall between Shuswap lake and Kamloops being only 15 feet. The valley between Kamloops and Chase is from 1 mile to 3 miles wide, and is very suitable to mixed farming and fruit growing. The drainage area is 400 square miles, and a large percentage of this land may be cultivated or used for grazing land. The one great drawback is the lack of water for irrigation.

The remaining 6,600 square miles of the South Thompson watershed are drained by the Shuswap lakes. The chief feeders of this body of water are Adams river, Anstey river, Seymour river, Eagle river, Shuswap river, and Salmon river. The precipitation throughout the catchment basins of these streams averages about 30 inches, the Salmon being the only one in the Dry Belt. Adams river is an ideal power stream, and also drains a fertile and well-timbered country. The C.P.R. runs along Eagle river, and it was at its source (Clanwilliam) that the C.P.R. connected its transcontinental line some twenty odd years ago. Shuswap river has two good power sites on it, one below Sugar lake, the other below Mabel lake. Immense timber limits are held around Mabel and Sugar lakes. Shuswap river drains the famous Okanagan valley from Armstrong north. Salmon river drains the Grand Prairie district, so well known as a mixed farming and ranching country. For further information on these streams, see the individual gazetteers and reports.

South Thompson, rising as it does in a humid mountain district, has at its headwaters an annual precipitation of 30 inches to 40 inches. At its confluence with the North Thompson in the arid belt the annual precipitation is from 8 inches to 13 inches.

The South Thompson is navigable during high water, and every week during the summer steamers ply between Kamloops, Chase, Sicamous, Salmon Arm and Anstey Arm.

The gauging station on the South Thompson (201) was established by C. E. Richardson on October 20, 1911, below Little Shuswap lake near the town of Chase, but daily gauge readings taken by the Adams River Lumber Co. since April, 1911, have been secured. The measuring section is located immediately below the lake in the same section as the Adams River Lumber Company's Upper wharf. The wharf is 150 feet from the left bank, and this distance is spanned by a bridge. The river here is

about 450 feet wide, and a cable is stretched across the remaining 300 feet when measurements are made. The gauge is a standard vertical staff gauge and is fastened to a pile in the measuring section. Measurements are made from the bridge between the left bank and the wharf and from a boat steadied by the cable for the remaining part of the distance. This cable cannot be left permanently in place on account of the navigation on the river. The right bank is high and sparsely timbered, the left bank is gently sloping and clean. The stream is in one channel, with a gravel and sand bottom, and there is no possibility of overflow. The depth varies from 15 feet to 25 feet.

Three bench-marks have been established and their elevations, referred to the datum of the gauge, are as given below:—

B.M. No. 1.—Nail head on the top of the pile to which the gauge is fastened. Elevation, 15·20 feet.

B.M. No. 2.—Nail head on the pile on the upstream side of the wharf, across from the gauge. Elevation, 15·59 feet.

B.M. No. 3.—Nail head on the pile on the upstream side of the wharf 30 feet from the gauge. Elevation, 15·95 feet.

The maximum flow since April, 1911, was 36,000 c.f.s., and took place on June 28, 1911. The minimum flow was 2,400 c.f.s., and took place on March 1, 1912.

(3) From Kamloops the river flows into Kamloops lake, a lake about 20 miles long and from 1 to 2 miles wide. As the river leaves the lake the fall becomes greater and, in the 20 miles to Ashcroft, there is a drop of 200 feet. After leaving Ashcroft the river flows through the Black canyon. Between Ashcroft and Spences Bridge the river is very swift, and in the 25 miles there is a fall of 225 feet. Between Spences Bridge and Lytton the river is in a canyon practically all the way (30 miles). The fall in this distance is 317 feet. In 1894 the Ashcroft bridge was carried away; in five hours the debris was at Lytton, showing an average velocity of over 10 miles an hour. At Lytton, Thompson river discharges into the Fraser. The C.P.R. follows the left bank of the river from Chase to Lytton. The C.N.R. comes down the North Thompson and then follows the right bank practically all the way to Lytton. This eliminates any power possibilities.

There are good bench lands along both sides of the Thompson between Kamloops and Spences Bridge, but lack of water is the great difficulty in cultivation all through this district. The precipitation is very small not exceeding 10 inches to 13 inches.

The three largest tributaries of Thompson river below Kamloops are the Deadman, entering from the right; below Savona lake, the Bonaparte entering from the right at Ashcroft and the Nicola entering from the left at Spence's Bridge. All drain rich agricultural districts and ranching countries. Practically the whole drainage below Kamloops and above Spences Bridge consists of a rolling-hill country, unexcelled for ranching, and rich, agriculturally, where water can be obtained.

There is gold in the Thompson. Iron is prevalent in the Kamloops district, and three coal mines are working at Merritt in the Nicola valley.

The Thompson drains the most settled part of the interior of British Columbia, with the exception of the lower Okanagan valley. The climate generally might be described as hot and dry in the summer, with a cold short winter, with little snow. The country is well supplied with game, and fishing is good in both the large and small streams and lakes.

There are two stations on the main Thompson, one at Kamloops just below the junction of its component branches, and one at Spences Bridge, about 30 miles from the mouth.

The station at Kamloops (202) was established by C. E. Richardson on September 8, 1911, and the measuring section is located on the upstream side of the lower traffic

bridge, and three-quarters of a mile below the confluence of the north and south branches. The gauge is a standard vertical staff gauge, 18 feet long, and is divided into feet and quarter-feet. It is fastened to the inside of the cribbing that supports the swing bridge. The meter is suspended from a cable, and must be weighted with from 15 to 30 pounds of lead. The section is a uniform one, 800 feet wide, while the banks are high and clean. The elevation of the gauge datum referred to the C.P.R., at the middle of the cow protectors just south of the bridge, is 22·69 feet.

The river rises from the end of March to the middle of June from 12 to 17 feet, receding slowly till December, when it freezes over and remains fairly constant till March. Gauge readings were taken on the Kamloops gauge by the Meteorological Service during 1911, and by its courtesy they are published, together with the corresponding discharges according to the rating of the Hydrographic Survey.

The station at Spences Bridge (204) was established on October 25, 1911, by C. E. Richardson, and continuous readings have since been obtained. The measuring section is located on the downstream side of the highway bridge, and measurements are made by cable suspension. The gauge is located on the upstream side of the bridge, about 200 feet from the left bank. It is a chain gauge, 39·14 feet from tip to tip. Graduations are marked in feet and tenths, in black paint, along the handrail for 20 feet.

The banks of the stream slope gradually to the bridge abutments and consist of rocks and broken stone. The bed of the stream is gravel, and varies in depth from 7 feet to 20 feet. The stream is confined to one channel, broken only by the bridge piers. In ordinary stages there are only two parts to the channel, but at high water there are four.

The C.P.R. rail (altitude 776·0 feet above sea level) is 69·4 feet above the datum of the gauge. Thus, the elevation of the gauge datum is 706·6 feet above sea level.

Thompson river does not freeze over at Spences Bridge.

DISCHARGE MEASUREMENTS of Thompson River, at Kamloops, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Sept 8	C. E. Richardson, W. M. Carlyle	1048	715	11,600	1·90	4·37	22,000
Oct. 3	C. E. Richardson	1048	706	10,100	1·36	2·50	13,700
Dec. 1	C. E. Richardson, K. H. Smith	1048	695	8,650	0·83	0·50	7,180
1912.							
Mar. 5	C. E. Richardson	1047	685	8,050	0·50		3,980*
Apr. 2	C. E. Richardson, H. J. E. Keys	1057	690	8,037	0·51	0·20	4,090
July 9	C. E. Richardson	1048	767	14,300	3·33	8·50	47,700
July 22	" "	1048	768	13,100	2·74	7·07	35,900
Aug. 23	" "	1048	765	12,300	2·70	6·20	33,400

*Ice cover.

DAILY GAUGE HEIGHT AND DISCHARGE of Thompson River, at Kamloops, for 1911.

DAY.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	.....	2·08	12,120	9·83	58,470	12·8	84,100	7·92	43,540	5·27	26,650
2	.....	.....	3·00	15,800	11·0	68,500	12·9	85,000	7·92	43,540	5·44	27,600
3	.....	.....	3·31	17,140	11·7	74,500	13·3	88,600	7·50	40,600	5·58	28,380
4	0·36	5,980	3·86	19,640	12·0	77,100	12·6	82,300	7,33	39,410	5·10	25,700
5	0·58	6,640	4·19	21,160	11·7	74,500	12·4	80,500	7·06	37,520	4·78	24,000
6	0·75	7,200	4·75	23,850	11·2	70,200	12·2	78,700	7·00	37,100	5·00	25,200
7	1·10	8,400	5·36	27,160	10·7	65,900	12·1	77,900	6·73	35,210	4·83	24,250
8	1·19	8,670	5·81	29,660	10·4	63,400	12·0	77,100	6·73	35,210	4·44	22,300
9	1·27	8,980	5·69	28,950	10·2	61,700	12·1	77,900	6·58	34,180	4·78	24,000
10	1·00	8,100	5·50	27,900	10·3	62,500	11·8	75,300	6,48	33,600	4·06	20,600
11	1·00	8,100	5·50	27,900	10·4	63,400	11·5	72,700	6·17	31,820	3·94	20,000
12	1·23	8,820	5·75	29,300	11·2	70,200	11·1	69,300	6·00	30,809	3·81	19,440
13	1·42	9,580	5·81	29,660	11·8	75,300	10·8	66,800	5·75	29,300	3·75	19,150
14	1·67	10,480	6·00	30,800	13·0	85,900	10·4	63,400	5·63	28,650	3·89	19,760
15	1·55	10,050	6·17	31,820	13·9	94,100	10·2	61,700	5·73	29,180	4·42	22,200
16	1·44	9,660	6·44	33,400	14·5	99,600	10·2	61,700	5·92	30,320	4·39	22,050
17	1·33	9,220	7·25	38,850	14·8	102,400	10·3	62,500	5·50	27,900	4·44	22,300
18	1·47	9,780	8·25	45,950	14·8	102,400	10·4	63,400	5·36	27,160	4·48	22,500
19	1·50	9·900	8·92	51,060	14·6	100,500	10·4	63,400	5·17	26,120	4·00	20,300
20	1·67	10,480	9·00	51,700	14·3	97,800	10·0	60,000	5·19	26,240	3·73	19,050
21	1·67	10,480	9·00	51,700	13·4	89,500	9·73	57,640	5·59	28,440	3·50	18,000
22	1·75	10,800	8·75	49,800	12·8	84,100	9·44	55,320	5·52	28,020	3·73	19,050
23	1·83	11,120	8·83	50,410	12·4	80,500	9·23	53,570	5·45	27,650	3·64	18,600
24	2·00	11,800	8·50	47,900	12·3	79,600	9·23	53,570	5·23	26,450	3·50	18,000
25	2·17	12,410	8·42	47,260	12·2	78,700	9·08	52,340	5·00	25,200	3·23	16,750
26	2·50	13,700	8·33	46,540	12·2	78,700	9·23	53,570	5·02	25,300	3·00	15,800
27	2·75	14,700	8·25	45,950	12·1	77,900	9·39	54,920	4·83	24,250	2·94	15,500
28	2·83	15,020	8·23	45,810	12·7	83,200	9·08	52,340	4·92	24,720	2·94	15,500
29	2·67	14,380	8·25	45,950	12·8	84,100	8·19	45,520	4·56	22,900	2·73	14,620
30	2·83	15,020	8·39	47,020	12·9	85,000	8·36	46,780	4·33	21,750	2·60	14,100
31	.....	.....	8·92	51,060	.....	.....	8·10	44,800	4·60	23,100	.....	.....

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MONTHLY DISCHARGE of Thompson River, at Kamloops, for 1911.

(Drainage area, 14,400 square miles.)

Month.	Discharge in Second Feet.				Run-Off.	
	Maximum	Minimum	Mean	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
April	15,020	5,980	10,300	0·72	0·8	612,900
May	51,700	12,120	36,200	2·51	2·9	2,225,900
June	102,400	58,470	79,700	5·53	6·2	4,742,500
July	88,600	44,800	65,200	4·53	5·2	4,009,000
August	45,540	21,750	30,500	2·12	2·4	1,875,400
September	28,380	14,100	20,700	1·44	1·6	1,231,700

NOTE.—Accuracy "A," up to 69,000 c.f.s.; Accuracy "B," over 69,000 c.f.s. Gauge read by Meteorological Service, and discontinued on September 30. On December 1, 1911, a metering was made under partial winter conditions. Discharge, 7,180 c.f.s. On March 5, 1912, under ice cover, the discharge was 3,980 c.f.s. From gauge readings during the frozen season, it would seem that the discharge decreased gradually from 7,180 second-feet on December 1, 1911, to 3,840 second-feet on March 24, 1912, at which latter date open conditions again existed.

DAILY GAUGE HEIGHT AND DISCHARGE

DAY.	MARCH.		APRIL.		MAY.		JUNE.		JULY.	
	Gauge height.	Discharge	Gauge height	Discharge	Gauge height	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			−0·17	4,460	3·62	18,500	10·58	64,920	10·17	61,430
2			−0·17	4,460	4·00	20,300	10·17	61,430	9·62	56,760
3			−0·08	4,660	4·17	21,080	9·67	57,160	9·17	53,060
4			−0·08	4,660	4·33	21,750	9·46	55,480	9·00	51,700
5			0·08	4,900	4·38	22,000	9·12	52,660	9·00	51,700
6			0·08	5,140	4·50	22,600	8·79	50,120	9·00	51,700
7			0·08	5,140	4·71	23,650	8·54	48,180	8·96	51,380
8			0·08	5,140	5·00	25,200	8·62	48,760	8·71	49,480
9			0·12	5,260	5·42	27,500	8·96	51,380	8·38	46,940
10			0·21	5,530	6·00	30,800	9·50	55,800	8·17	45,360
11			0·33	5,890	6·29	32,540	9·50	55,800	8·08	44,660
12			0·50	6,400	6·33	32,780	9·50	55,800	8·20	45,600
13			0·62	6,760	6·42	33,300	9·87	58,830	8·08	44,660
14			0·79	7,360	6·83	35,910	10·67	65,660	8·08	44,660
15			1·08	8,340	7·38	39,760	10·50	64,200	8·20	45,600
16			1·17	8,610	7·75	42,350	11·00	68,500	7·37	39,690
17			1·42	9,580	9·25	53,750	10·87	67,360	7·62	41,440
18			1·54	10,020	9·79	58,120	10·91	69,930	7·38	39,760
19			1·71	10,640	9·58	56,440	11·17	69,930	7·25	38,850
20			1·91	11,440	9·38	54,840	11·54	73,060	7·17	38,290
21			1·95	11,600	9·38	54,840	11·67	74,230	7·17	38,290
22			2·08	12,120	9·87	58,830	12·00	77,100	7·04	37,380
23			2·21	12,540	10·38	63,220	12·12	78,060	7·25	38,850
24	−0·42	3,840	2·29	12,860	10·75	66,350	12·17	78,460	7·42	40,040
25	−0·33	4,040	2·50	13,700	10·96	68,140	12·00	77,100	7·25	38,850
26	−0·33	4,040	2·75	14,700	11·12	69,480	11·79	75,220	7·25	38,850
27	−0·25	4,250	3·00	15,800	11·38	71,720	11·71	74,580	7·29	39,130
28	−0·17	4,460	3·04	15,960	11·83	75,570	11·67	74,230	7·04	37,380
29	−0·17	4,460	3·00	15,800	11·87	75,930	11·54	73,060	6·79	35,630
30	−0·25	4,250	3·29	17,050	11·62	73,780	10·96	68,140	6·71	35,070
31	−0·17	4,460			11·08	69,140			6·71	35,070

of Thompson River, at Kamloops, for 1912.

August.		September.		October.		November.		December.		Day.
Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
6·83	35,910	4·75	23,850	2·5	13,700	1·5	9,900	1·0	8,100	1
6·83	35,910	4·71	23,650	2·5	13,700	1·7	10,600	0·8	7,400	2
6·75	35,350	4·71	23,650	2·4	13,300	1·5	9,900	0·8	7,400	3
6·71	35,070	4·75	23,850	2·5	13,700	1·5	9,900	0·8	7,400	4
6·71	35,070	4·75	23,850	2·5	13,700	1·5	9,900	0·8	7,400	5
6·67	34,790	4·62	23,200	2·4	13,300	1·3	9,100	0·7	7,000	6
6·67	34,790	4·50	22,600	2·8	14,900	1·2	8,700	0·7	7,000	7
6·29	32,540	4·50	22,600	2·6	14,100	1·2	8,700	0·7	7,000	8
6·00	30,800	4·50	22,600	2·5	13,700	1·2	8,700	0·8	7,400	9
6·08	31,280	4·50	22,600	2·5	13,700	1·2	8,700	0·8	7,400	10
6·67	34,790	4·50	22,600	2·5	13,700	1·2	8,700	0·8	7,400	11
6·91	36,470	4·50	22,600	2·4	13,300	1·2	8,700	0·8	7,400	12
6·88	36,260	4·42	22,200	2·2	12,500	1·2	8,700	0·8	7,400	13
6·50	33,700	4·42	22,200	2·1	12,200	1·2	8,700	0·8	7,400	14
6·21	32,060	4·42	22,200	2·2	12,500	1·2	8,700	0·8	7,400	15
6·12	31,520	4·25	21,400	2·1	12,200	1·0	8,100	0·8	7,400	16
5·96	30,560	4·08	20,700	2·1	12,200	1·2	8,700	0·8	7,400	17
6·17	31,820	4·00	20,300	2·2	12,500	1·1	8,400	0·7	7,000	18
5·91	30,260	3·96	20,100	2·4	13,300	1·1	8,400	0·7	7,000	19
5·83	29,780	3·79	19,350	2·5	13,700	1·0	8,100	0·8	7,400	20
6·00	30,800	3·79	19,350	2·2	12,500	1·1	8,400	0·8	7,400	21
6·12	31,520	3·50	18,000	2·0	11,800	1·2	8,700	0·8	7,400	22
6·21	32,060	3·37	17,380	2·0	11,800	1·2	8,700	0·8	7,400	23
6·46	33,500	3·25	16,850	2·0	11,800	1·2	8,700	0·7	7,000	24
6·79	35,630	3·21	16,650	2·0	11,800	1·0	8,100	0·7	7,000	25
6·67	34,720	3·00	15,800	2·0	11,800	1·0	8,100	0·5	6,400	26
6·46	33,500	3·00	15,800	2·0	11,800	1·0	8,100	0·5	6,400	27
5·62	28,600	2·83	15,020	1·8	11,000	1·0	8,100	0·7	7,000	28
5·42	27,500	2·75	14,700	1·8	11,000	1·0	8,100	0·5	6,400	29
5·21	26,350	2·75	14,700	1·8	11,000	1·0	8,100	0·5	6,400	30
5·00	25,200	....	....	1·7	10,600	....	....	0·5	6,400	31

MONTHLY DISCHARGE of Thompson River, at Kamloops, for 1912.

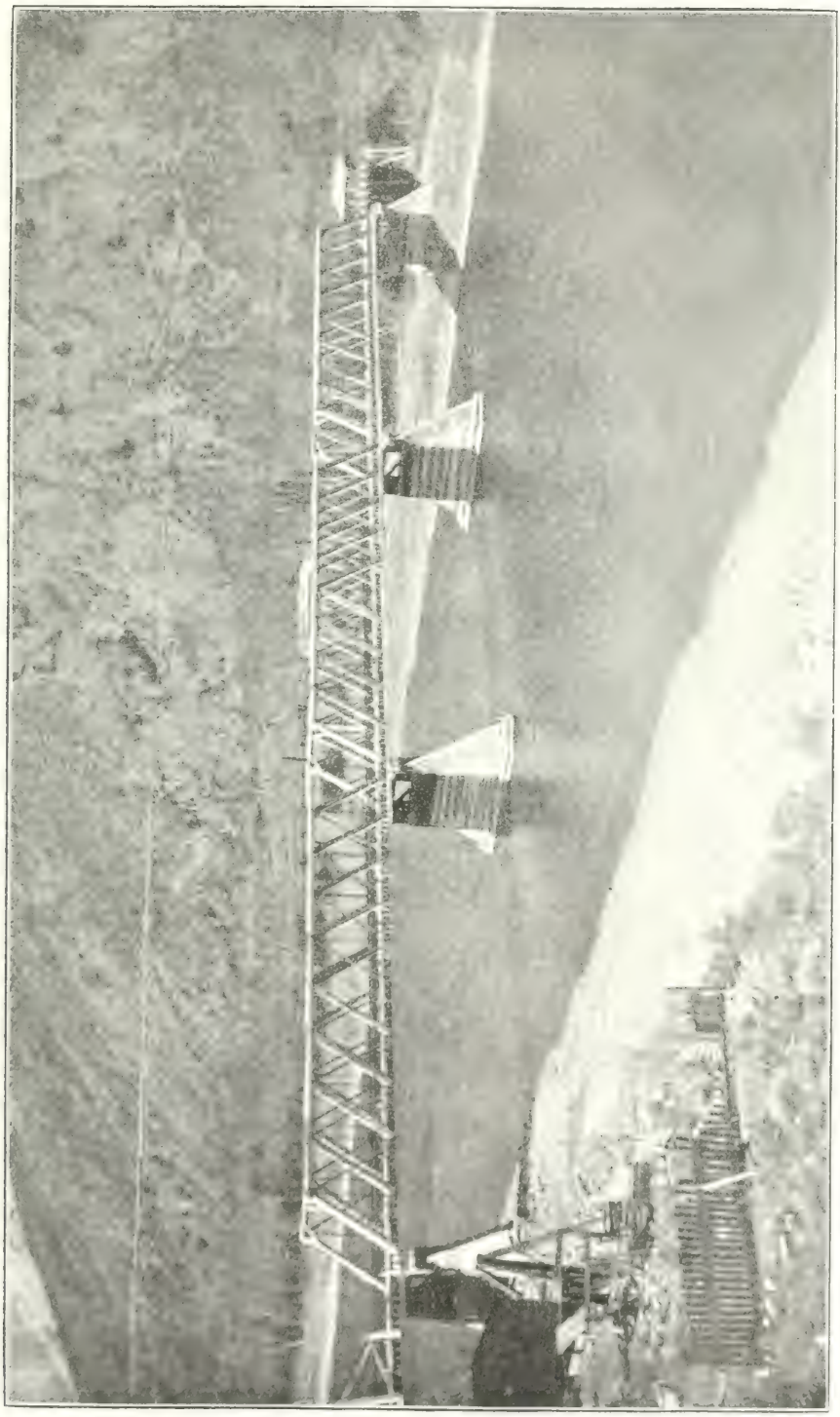
(Drainage area, 14,400 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
April	17,050	4,460	9,217	0·64	0·71	548,630
May	75,930	18,500	45,812	3·18	3·67	2,816,100
June	78,460	48,180	64,763	4·49	5·00	3,855,900
July	61,430	35,070	43,783	3·04	3·50	2,693,200
August	36,470	25,200	32,520	2·26	2·61	1,998,300
September	23,850	14,700	20,345	1·41	1·57	1,207,900
October	14,900	10,600	12,670	·88	1·00	780,000
November	10,600	8,100	8,747	·61	·68	520,000
December	8,100	6,400	7,158	·50	·58	440,000

NOTE.—Accuracy "A," up to 60,000 c.f.s. Accuracy "B" over 60,000 c.f.s. Ice conditions existed at the station from December 1, 1911, to March 24, 1912. In that interim the discharge decreased gradually from 7,180 to 3,840 second-feet.

DISCHARGE MEASUREMENTS of Thompson River, at Spences Bridge, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Oct. 25	C. E. Richardson	1048	297	2,780	3·7	4·0	10,300
Nov. 25	"	1048	340	2,435	3·4	2·8	8,180
1912.							
Feb. 17	C. G. Cline	1046	324	2,200	2·7	1·4	5,900
Mar. 30	"	1046	330	1,960	2·4	1·2	4,770
May 1	C. E. Richardson	1048	485	3,800	5·5	6·55	20,700
May 25	C. G. Cline	1046	464	8,080	10·5	15·9	84,900
July 25	B. Corbould	1044	433	6,135	11·7	11·7	50,200



Gauging Station on Thompson River at Spences Bridge.

DAILY GAUGE HEIGHT AND DISCHARGE of Thompson River, at Spences Bridge, for 1911.

Day.	NOVEMBER.		DECEMBER.	
	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1		9,200	2·7	7,540
2		9,000	2·8	7,750
3		8,800	2·8	7,750
4		8,600	2·5	7,130
5		8,400	2·4	6,930
6	3·0	8,200	2·5	7,130
7	3·0	8,200	2·4	6,930
8	3·0	8,200	2·4	6,930
9	2·9	7,970	2·5	7,130
10	2·8	7,750	2·4	6,930
11	2·7	7,540	2·4	6,930
12	2·4	6,930	2·4	6,930
13	2·2	6,550	2·3	6,740
14	2·2	6,550	2·3	6,740
15	2·2	6,550	2·2	6,550
16	2·2	6,550	2·1	6,370
17	2·2	6,550	2·1	6,370
18	2·2	6,550	2·1	6,370
19	2·2	6,550	2·1	6,370
20	2·3	6,740	2·2	6,550
21	2·5	7,130	2·2	6,550
22	2·5	7,130		6,840
23	2·5	7,130	2·5	7,130
24	2·6	7,330	2·5	7,130
25	2·8	7,750	1·8	5,870
26	2·7	7,540	1·7	5,720
27	2·6	7,330	1·5	5,430
28	2·4	6,930	1·4	5,290
29	2·8	7,750	1·3	5,160
30	2·6	7,330	1·2	5,030
31			1·1	4,910

MONTHLY DISCHARGE of Thompson River, at Spences Bridge, for 1911.

(Drainage area, 21,000 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
November	9,200	6,550	7,491	0·4	0·4	446,000
December	7,750	4,910	6,553	0·3	0·36	403,000

NOTE.—Station established October 25, 1911. Channel open all the year.
Accuracy in November, "C"; in December, "B."

Daily Gauge Height and Discharge of

Day.	January.		February.		March.		April.		May.		June.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1....	1·4	5,290	0·9	4,700	1·2	5,030	1·4	5,290	.....	20,600	16·2	87,600
2....	1·5	5,430	0·9	4,700	1·4	5,290	1·4	5,290	.....	21,200	15·4	80,400
3....	1·5	5,430	0·8	4,600	1·4	5,290	1·5	5,430	.....	21,800	15·1	77,800
4....	1·5	5,430	0·9	4,700	1·3	5,160	1·5	5,430	.....	22,400	14·6	73,400
5....	1·3	5,160	1·0	4,800	1·3	5,160	1·5	5,430	.....	23,000	14·2	70,000
6....	1·1	4,910	0·9	4,700	1·3	5,160	1·5	5,430	7·4	23,600	13·8	66,600
7....	1·2	5,030	1·0	4,800	1·2	5,030	1·6	5,570	7·9	26,100	13·4	63,200
8....	1·2	5,030	1·1	4,910	1·2	5,030	1·6	5,570	8·4	28,600	13·3	62,400
9....	2·5	7,130	1·3	5,160	1·1	4,910	1·6	5,570	9·0	31,800	13·7	65,700
10....	2·6	7,330	1·3	5,160	1·1	4,910	1·7	5,720	9·6	35,400	14·0	68,400
11....	2·5	7,130	1·5	5,430	1·2	5,030	1·8	5,870	10·6	41,800	14·1	69,200
12....	2·7	7,540	1·5	5,430	1·2	5,030	2·5	7,130	10·8	43,200	14·2	70,000
13....	3·2	8,600	1·5	5,430	1·3	5,160	2·6	7,330	11·2	46,000	14·3	70,800
14....	3·3	8,800	1·6	5,570	1·3	5,160	2·7	7,540	11·5	48,100	14·4	71,600
15....	3·2	8,600	1·5	5,430	1·3	5,160	2·8	7,750	11·9	51,200	15·2	78,600
16....	3·0	8,200	1·4	5,290	1·4	5,290	3·2	8,600	12·8	58,400	15·4	80,400
17....	2·8	7,750	1·4	5,290	1·4	5,290	3·5	9,400	13·6	64,800	15·5	81,300
18....	2·6	7,330	1·4	5,290	1·3	5,160	4·0	10,600	14·8	70,000	15·6	82,200
19....	3·0	8,200	1·6	5,570	1·2	5,030	4·3	11,500	14·6	73,400	15·6	82,200
20....	3·3	8,800	1·6	5,570	1·2	5,030	4·4	11,800	14·7	74,300	15·8	84,000
21....	3·0	8,200	1·5	5,430	1·2	5,030	4·5	12,100	15·0	77,000	16·0	85,800
22....	3·0	8,200	1·5	5,430	1·2	5,030	4·9	13,400	14·8	75,200	16·4	89,400
23....	2·8	7,750	1·5	5,430	1·2	5,030	5·3	14,800	15·0	77,000	16·6	91,200
24....	2·6	7,330	1·3	5,160	1·2	5,030	5·7	16,400	16·0	85,800	16·4	89,400
25....	1·9	6,030	1·3	5,160	1·2	5,030	5·9	17,200	15·8	84,000	16·4	89,400
26....	1·5	5,430	1·3	5,160	1·2	5,030	6·0	17,600	16·2	87,600	16·4	89,400
27....	1·4	5,290	1·4	5,290	1·2	5,030	.....	18,200	16·6	91,200	16·4	89,400
28....	1·8	5,870	1·4	5,290	1·2	5,030	.....	18,800	16·7	92,100	16·3	88,500
29....	1·4	5,290	1·2	5,030	1·2	5,030	.....	19,400	16·7	92,100	16·4	89,400
30....	1·3	5,160	.....	.....	1·2	5,030	.....	20,000	16·6	91,200	15·9	84,900
31 ..	1·2	5,030	...	...	1·2	5,030	.....	.....	16·4	89,400	.....	.....

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Thompson River, at Spences Bridge, for 1912.

July.		August.		September.		October.		November.		December.		Day.
Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
15·4	80,400	10·9	43,900	8·7	30,100	.....	20,700	4·2	11,200	3·3	8,800	1
14·8	75,200	10·9	43,900	8·7	30,100	.....	20,100	4·1	10,900	3·3	8,800	2
14·3	70,800	10·8	43,200	8·7	30,100	.....	19,500	4·2	11,200	3·2	8,600	3
13·7	65,700	10·7	42,500	8·6	29,600	.....	18,900	4·1	10,900	3·2	8,600	4
13·6	64,800	10·7	42,500	8·5	29,100	.....	18,300	4·1	10,900	3·2	8,600	5
13·7	65,700	10·8	43,200	8·4	28,600	.....	17,700	4·0	10,600	3·2	8,600	6
13·4	63,200	10·8	43,200	8·4	28,600	.....	17,100	3·9	10,400	3·2	8,600	7
13·2	61,600	10·8	43,200	8·4	28,600	.....	16,500	3·9	10,400	3·1	8,400	8
13·2	61,600	10·8	43,200	8·3	28,100	.....	15,900	3·8	10,200	3·1	8,400	9
12·9	59,200	10·4	40,400	8·2	27,600	5·4	15,200	3·7	10,000	3·1	8,400	10
12·6	56,800	10·3	29,700	8·2	27,600	5·4	15,200	3·7	10,000	3·0	8,200	11
12·5	56,000	10·4	40,400	8·1	27,100	5·3	14,800	3·6	9,700	3·0	8,200	12
12·3	54,400	10·5	41,100	8·1	27,100	.....	14,400	3·6	9,700	3·0	8,200	13
12·3	54,400	10·7	42,500	8·2	27,600	5·1	14,100	3·5	9,400	3·0	8,200	14
12·3	54,400	10·8	43,200	8·1	27,100	5·1	14,100	3·4	9,160	3·0	8,200	15
12·3	54,400	10·6	41,800	8·0	26,600	5·1	14,100	3·3	8,800	3·0	8,200	16
12·1	52,800	10·6	41,800	7·8	25,600	5·1	14,100	3·3	8,800	2·9	7,970	17
12·0	52,000	10·5	41,100	7·7	25,100	5·1	14,100	3·2	8,600	2·9	7,970	18
11·8	50,400	10·4	40,400	7·6	24,600	5·2	14,400	3·3	8,800	2·9	7,970	19
11·6	48,800	10·1	38,400	7·5	24,100	5·2	14,400	3·3	8,800	2·9	7,970	20
11·4	47,400	10·1	38,400	7·4	23,600	5·2	14,400	3·3	8,800	2·9	7,970	21
11·4	47,400	10·1	38,400	7·2	22,600	5·1	14,100	3·4	9,160	2·9	7,970	22
11·5	48,100	10·1	38,400	7·0	21,800	5·1	14,100	3·4	9,160	2·8	7,750	23
11·6	48,800	10·2	39,000	6·9	21,300	5·0	13,800	3·4	9,160	2·8	7,750	24
11·8	50,400	10·3	39,700	6·8	20,800	4·9	13,400	3·5	9,400	2·8	7,750	25
11·7	49,600	10·4	40,400	6·7	20,400	4·8	13,000	3·5	9,400	2·7	7,540	26
11·6	48·800	10·3	39,700	6·5	19,600	4·7	12,700	3·5	9,400	2·7	7,540	27
11·5	48,100	10·1	38,400	6·3	18,800	4·5	12,100	3·4	9,160	2·7	7,540	28
11·3	46,700	10·0	37,800	6·7	20,400	4·4	11,800	3·4	9,160	2·7	7,540	29
11·2	46,000	9·7	36,000	6·9	21,300	4·3	11,500	3·4	9,160	2·6	7,330	30
10·9	43,900	9·2	33,000	.....	.....	4·2	11,200	.....	.....	2·5	7,130	31

MONTHLY DISCHARGE of Thompson River, at Spences Bridge, for 1912.

(Drainage area, 21,000 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
January	8,800	4,910	6,668	0·3	0·3	410,000
February	5,570	4,600	5,169	0·25	0·3	297,000
March	5,290	4,910	5,085	0·24	0·3	312,000
April	20,000	5,290	10,338	0·5	0·6	613,000
May	92,100	20,600	57,042	2·7	3·1	3,500,000
June	91,200	62,400	79,087	3·8	4·2	4,710,000
July	80,400	43,900	55,735	2·6	3·0	3,420,000
August	43,900	33,000	40,606	1·9	2·2	2,500,000
September	30,100	18,800	25,453	1·2	1·3	1,510,000
October	20,700	11,200	15,023	0·7	0·8	923,000
November	11,200	8,600	9,681	0·5	0·6	576,000
December	8,800	7,130	8,087	0·4	0·5	497,000
The period	92,100	4,600	26,498	1·3	17·2	19,268,000

NOTE.—Accuracy, B"." except in October, when it was "C."

DISCHARGE MEASUREMENTS of South Thompson River, at near Chase, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
Oct. 30	C. E. Richardson	1048	415	4,450	1·3	0·71	5,780
1912.							
Mar. 1	"	1047	397	3,710	0·68	−0·83	2,380
May 18	"	1048	465	6,490	3·03	5·50	19,600
June 13	"	1048	465	7,190	4·29	7·17	30,800
June 21	"	1048	495	7,600	4·46	8·0	33,800
July 24	"	1048	465	6,200	3·18	5·0	19,600
Sept. 5	"	1049	445	5,180	2·25	2·98	11,600

SESSIONAL PAPER No. 25f

GAUGE HEIGHTS AND DAILY DISCHARGE of South Thompson River, at Chase, for 1911.

Day.	April.		May.		June.		July.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet	Sec.-ft.	Feet	Sec.-ft.	Feet	Sec.-ft.
1				9,240	5·17	20,280	8·33	36,050
2			2·25	9,450	5·33	21,050		35,850
3				9,900	5·75	23,050	8·25	35,650
4				10,300		24,100	8·17	35,250
5				10,900	6·17	25,150	8·0	34,400
6			2·91	11,430	6·25	25,550	8·0	34,400
7				11,200		25,750	7·91	33,850
8				10,950	6·33	25,950	7·91	33,850
9			2·67	10,710	6·33	25,950		33,850
10				10,960	6·33	25,950	7·91	33,850
11			2·83	11,190	6·42	26,400	7·83	33,450
12				11,700	6·67	27,650	7·75	33,050
13				12,200	6·75	28,050	7·58	32,200
14				12,650	7·00	29,300	7·42	31,400
15			3·42	13,080	7·33	30,950	7·33	30,950
16				13,700	7·58	32,200		30,550
17			3·75	14,300	7·08	29,700	7·17	30,150
18			3·91	14,940		32,000	6·91	28,850
19			4·25	16,300	8·17	35,250		28,200
20			4·5	17,400	8·33	36,050		27,500
21				17,900	8·33	36,050	6·5	26,800
22	1·17	6,710	4·75	18,400	8·33	36,050	6·33	25,950
23		6,985	4·91	19,150	8·33	36,050	.....	25,100
24	1·42	7,260		19,350	8·33	36,050	6·0	24,300
25	1·50	7,500	5·0	19,600		36,050		23,650
26	1·67	7,840	5·0	19,600	8·33	36,050	5·75	23,050
27	1·83	8,220	5·0	19,600	8·42	36,520	.....	22,200
28	1·91	8,530	5·0	19,600	8·42	36,520		21,400
29	2·0	8,809	5·0	19,600	8·42	36,520	5·25	20,650
30		9,029	5·0	19,600	8·33	36,050		19,900
31			5·17	20,280			4·92	19,200

MONTHLY DISCHARGE of South Thompson River, at Chase, for 1911.

(Drainage area, 7,000 square miles.)

Month.	Discharge in Second Feet			Run Off	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
May	20,280	9,240	14,680	2·09	2·41	903,900
June	36,520	20,280	30,410	4·34	4·84	1,809,000
July	36,050	19,200	29,210	4·17	4·81	1,795,000

NOTE.—Accuracy, "A."

DAILY GAUGE HEIGHT AND DISCHARGE of

DAY.	APRIL.		MAY.		JUNE.		JULY.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			2·75	10,950	7·83	33,450	7·5	31,800
2			2·82	11,160	7·83	33,450	7·33	30,950
3			2·91	11,430		33,250	7·17	30,150
4			3·00	11,700	7·75	33,050	7·0	29,300
5				11,850	7·5	31,800	6·8	28,300
6				12,000	7·33	30,950	6·7	27,800
7			3·17	12,210	7·0	29,300	6·6	27,300
8				12,600	7·0	29,300	6·4	26,300
9			3·42	13,080	7·0	29,300	6·3	25,800
10	0·08	4,260	3·58	13,640	7·0	29,300	6·2	25,300
11	0·17	4,440	3·75	14,300	7·0	29,300	6·0	24,300
12	0·25	4,600		15,000	7·08	29,700	5·9	23,800
13	0·33	4,760	4·08	15,620	7·17	30,150	5·8	23,300
14	0·42	4,940	4·17	15,980	7·33	30,950	5·7	22,800
15	0·58	5,340	4·50	17,400	7·42	31,400	5·6	22,300
16	0·67	5,540	4·83	18,720	7·50	31,800	5·5	21,900
17	0·75	5,700		20,300	7·58	32,200	5·4	21,400
18	0·91	6,030	5·50	21,900	7·67	32,650	5·3	20,900
19	1·00	6,300	5·67	22,650	7·75	33,050	5·2	20,400
20	1·08	6,460	5·17	20,280	7·83	33,450	5·1	20,000
21	1·25	6,900	6·0	24,300	8·0	34,400	5·0	19,600
22	1·33	7,060	6·25	25,550	8·08	34,800	4·9	19,100
23	1·50	7·500	6·67	27,650	8·08	34,800	4·8	18,600
24	1·67	7,800	6·83	28,450	8·08	34,800	4·7	18,200
25	1·83	8,290	6·91	28,850	8·08	34,800	4·7	18,200
26	2·00	8,800	7·0	29,300	8·08	34,800	4·7	18,200
27	2·17	9,210	7·25	30,550	8·0	34,400	4·67	18,080
28	2·25	9,450	7·5	31,800	7·91	33,850	4·60	17,800
29	2·42	9,960	7·67	32,650	7·75	33,050	4·42	17,000
30	2·58	10,440	7·83	33,450	7·67	32,650	4·33	16,620
31			7·83	33,450			4·33	16,620

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South Thompson River, at Chase, for 1912.

August.		September.		October.		November.		December.		Day.
Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	
4·30	16,500	3·12	12,060	2·2	9,300	1·6	7,700	1·2	6·800	 1
4·20	16,100	3·08	11,940	2·2	9·300	1·6	7,700	1·2	6,800	 2
4·12	15,780	3·04	11,820	2·1	9,000	1·5	7,500	1·2	6,800	 3
4·0	15,300	2·96	11,580	2·0	8·800	1·5	7,500	1·2	6,800	 4
3·96	15,140	2·91	11,430	2·0	8,800	1·5	7,500	1·2	6·800	 5
3·87	14,780	2·91	11,430	2·0	8,800	1·5	7,500	1·2	6,800	 6
3·8	14,500	2·96	11,580	2·0	8,800	1·5	7,500	1·2	6·800	 7
3·7	14,100	3·0	11,700	2·0	8.800	1·4	7,200	1·2	6,800	 8
3·66	13,940	3·0	11,700	1·9	8,500	1·4	7,200	1·1	6,500	... 9
3·62	13,780	3·0	11,700	1·9	8,500	1·3	7,000	1·1	6,500	10
3·6	13,700	3·0	11,700	1·9	8,500	1·3	7,000	1·1	6,500	11
3·5	13,400	3·0	11,700	1·9	8,500	1·3	7,000	1·1	6,500	12
3·5	13,400	3·0	11,700	1·8	8,200	1·3	7,000	1·2	6,800	...13
3·5	13,400	3·0	11,700	1·8	8·200	1·2	6,800	1·2	6,800	...14
3·5	13,400	3·0	11,700	1·8	8·200	1·2	6,800	1·2	6,800	...15
3·5	13,400	2·96	11,580	1·8	8,200	1·2	6,800	1·2	6,800	16
3·5	13,400	2·91	11,430	1·8	8,200	1·2	6,800	1·2	6,800	17
3·5	13,400	2·87	11,320	2·0	8,800	1·2	6,800	1·2	6,800	18
3·5	13,400	2·83	11,190	2·0	8,800	1·2	6,800	1·2	6,800	19
3·5	13,400	2·8	11,100	2·0	8,800	1·2	6,800	1·2	6,800	20
3·5	13,400	2·7	10,800	2·0	8·800	1·2	6,800	1·2	6·800	21
3·46	13,240	2·62	10,560	2·0	8,800	1·2	6,800	1·2	6·800	22
3·25	12,450	2·54	10,320	2·0	8,800	1·2	6,800	1·2	6,800	23
3·25	12,450	2·5	10,200	2·0	8,800	1·2	6,800	1·2	6,800	24
3·25	12,450	2·46	10,080	1·9	8,500	1·2	6,800	1·2	6,800	25
3·25	12,450	2·4	9,900	1·9	8,500	1·2	6,800	1·2	6,800	26
3·37	12,880	2·35	9,750	1·9	8,500	1·2	6,800	1·2	6,800	27
3·30	12,600	2·3	9,600	1·9	8,200	1·2	6,800	1·2	6,800	28
3·25	12,450	2·25	9,450	1·8	8,200	1·2	6,800	1·2	6,800	29
3·20	12,300	2·25	9,450	1·7	7,900	1·2	6,800	1·2	6,800	30
3·17	12,210			1·7	7,900			1·2	6,800	...31

MONTHLY DISCHARGE of South Thompson River, at Chase, for 1912.

(Drainage area, 7,000 square miles.)

MONTH.	DISCHARGE IN SECOND-FEET.				RUN-OFF.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on Drainage area.	Total in acre-feet.
May	33,450	10,950	20,280	2·90	3·34	1,248,200
June	34,800	29,300	32,330	4·62	5·15	1,922,000
July	31,800	16,620	22,650	3·24	3·73	1,390,000
August	16,500	12,210	13,650	1·95	2·25	839,000
September	12,060	9,450	11,070	1·58	1·76	660,500
October	9,300	7,900	8,577	1·22	1·41	527,000
November	7,700	6,800	7,030	1·00	1·12	418,300
December	6,800	6,500	6,761	0·95	1·10	416,000

NOTE.—Open conditions exist nearly all year.
Accuracy, "A."

THREE-MILE CREEK.

Three-mile creek has its source in the hills between Kamloops lake and Guichon valley, at an elevation of 4,000 feet, and discharges into Kamloops lake near Savona, at an elevation of 1,200 feet. It is part of the Thompson drainage; its drainage area as measured from the Geological Survey map, dated 1895, scale 2 miles to an inch, is 62 square miles, of which the west fork has an area of 20 square miles, and the east of 20 square miles. This is a very contentious irrigation stream in the heart of the Dry Belt; the summers are hot and dry, the winters long and very cold (–30° F.); the mean annual precipitation is about 10 inches.

Three-mile creek has two branches, which join about 8 miles from the mouth. From the confluence to the mouth, the stream flows through a fertile valley, half a mile wide, bounded by bench lands, which would make excellent agricultural land, if the necessary water were available. There are no storage facilities on the west branch, but it is of more importance as it forms part of the Leighton diversion system (see station on Guichon creek). Mr. Leighton diverts water from Guichon creek into two small lakes, Tunkwa and Leighton, on the divide between the west branch of Three-mile creek and Guichon creek. The water is stored in these lakes, then conducted down the said west branch. The east branch has its source in a small lake from 15 to 20 acres in extent, which might be used as a storage reservoir; at present there is a 4-foot dam, but this might be greatly enlarged. During the summer of 1912 miscellaneous measurements were made near the mouth, and on the west branch; the former gives an idea of the water during the freshet, and the latter shows the amount of water in the east branch previous to the opening of the Leighton diversion gates. See miscellaneous measurements on Three-mile creek.

TOBY CREEK (422).

Toby creek is a stream about 35 miles long rising in the Selkirks, west of lake Windermere, at an elevation of from 6,000 feet to 9,000 feet. It flows in a northeasterly direction and discharges into the Columbia river 1 mile below lake Windermere, at an elevation of 2,700 feet. Toby creek varies in width from 50 feet to 200 feet and in depth from 3 feet to 6 feet. The drainage area is about 220 square miles.

The precipitation in the Toby creek drainage varies from 14 inches at the mouth to over 60 inches in the head-waters.

It deposits a great deal of silt and wash in the Columbia river and the bars at each of its two mouths are a great handicap to navigation. It has a very large freshet and, at times, it backs water into lake Windermere. Logs have floated down Toby creek and up the Columbia river 1 mile into lake Windermere.

The Columbia River Irrigated Fruitlands Company hold extensive irrigation records on this creek, and at present are constructing a flume with which they hope to irrigate thousands of acres of land along lake Windermere and the Columbia river.

The Columbia River Lumber Company hold valuable timber limits up this creek, and annually in June, July and August logs are carried down this creek to the Columbia river; then down the Columbia river 100 miles to the mill at Golden.

Power may be developed at three points on this stream.

(1) Two miles from the mouth there is a canyon 8 miles long. The fall in the canyon is 1,600 feet in 8 miles (by aneroid). At the mouth of the canyon the stream is 100 feet wide. The left bank is 100 feet high, rocky, steep, with a few scattered trees. The right bank is low, sloping and covered with heavy brush. At the head of the canyon the stream is 40 feet wide. The banks are steeply sloping and covered with heavy brush.

(2) Eleven miles from the mouth, there is a canyon 400 yards long, with a fall of 100 feet (measured by aneroid). At the foot of the canyon the stream is 60 feet wide. The banks are steeply sloping, rocky, covered with light brush and timber. The left bank rises in bluffs. At the head of the rapids the stream is 50 feet wide, the right bank steeply sloping, with light timber and brush.

(3) On Jumbo creek, 28 miles up stream, Jumbo creek enters on the left side (looking downstream). It carries about half the flow of Toby creek. On Jumbo creek there is a canyon 1,000 feet long with a head of 40 feet, of which 20 feet is a sheer fall at the head of the canyon. At the mouth of the canyon the stream is 30 feet wide with steep (20-foot) rocky banks, covered with timber. At the head of the canyon above the falls, the stream is 25 feet wide, with sloping rocky banks covered with brush. Below the falls the stream is 20 feet wide; the banks are 30 feet high and rocky. The falls have been blasted for the purpose of driving logs to the extent that now the falls are 60 feet high. An additional 20-foot head could be obtained by constructing a dam at the head of the falls. This dam would be 90 feet long. No good storage is known on Toby or Jumbo creeks.

Toby Creek (422).

The station on Toby creek was established May 28, 1912, by C. E. Richardson, assisted by H. C. Hughes. Measurements were made from the downstream side of the traffic bridge on the road from Athalmer to Wilmer, with a Price electric current meter and cable equipment. The initial point for sounding is located at the right abutment of the bridge. The channel above and below the station is straight for 50 feet, and the water is very swift. During all stages the river passes between the bridge abutments, but in low water there are two channels, one of which is shallow and the other varies from 3 to 6 feet in depth. The stream does not flow at right angles to the bridge; in fact the current is not at all uniform. For this reason the accuracy of the measurements cannot be too closely relied upon.

A standard vertical staff gauge is fastened to the cribbing on the right bank of the stream near the Athalmer race track, and about 1 miles above the measuring section. The datum of the gauge is referred to three bench-marks.

Discharge Measurements of Toby creek, near Athalmer, 1912.

Date.	Hydrographer.	Meter No.	Width	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 28	C. E. Richardson	1055	159	359	2·2	2·0	797
June 14	H. C. Hughes	1055	163	423	3·0	2·6	1,270
June 29	"	1055	163	397	2·8	2·48	1,110
July 23	"	1055	162	378	2·5	2·25	950
Sept. 28	C. E. Richardson	1055	75	122	2·3	0·46	270*

*Different section.

Daily Gauge Height and Discharge of Toby creek, near Athalmer, for 1912.

Day.	June.		July.		August.		September.	
	Gauge height.	Dicsharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	1·6	610	2·4	1,050	2·0	795	1·1	425
2	1·58	602	2·9	1,580	1·8	700	0·9	370
3	1·4	530	2·1	850	1·9	745	0·9	370
4	1·4	530	2·1	850	1·8	700	0·9	370
5	1·42	538	2·45	1,100	1·8	700	0·95	382
6	1·5	570	2·2	910	1·85	722	0·9	370
7	1·95	770	2·15	880	1·9	745	0·9	370
8	2·3	975	2·2	910	2·1	850	1·0	395
9	2·42	1,070	2·25	940	2·0	795	1·0	395
10	2·5	1,140	2·25	940	2·25	940	1·05	410
11	2·6	1,240	2·3	975	2·0	795	1·0	395
12		1,380	3·3	2,120	1·6	610	1·0	395
13	2·85	1,520	3·5	2,460	1·7	655	1·1	425
14	2·65	1,300	2·68	1,330	2·1	850		
15	2·40	1,050	2·75	1,410	2·25	942		
16	2·22	923	2·55	1,190	1·6	610		
17	2·9	1,580	2·3	975	1·35	510		
18	3·7	2,850	2·1	850	1·2	455		
19	3·65	2,750	2·8	1,460	1·4	530		
20	3·65	2,750	2·75	1,410	1·7	655		
21	3·7	2,850	2·7	1,350	2·25	940		
22	4·0	3,510	2·8	1,460	2·4	1,050		
23	3·75	2,960	2·4	1,050	2·55	1,190		
24	4·1	3,750	2·1	850	2·2	910		
25	3·8	3,060	2·25	940	2·0	795		
26	3·8	3,060	2·35	1,010	1·55	590		
27	3·4	2,280	2·2	910	1·65	632		
28	2·9	1,580	1·85	722	1·0	395	0·46	270
29	2·35	1,020	2·6	1,240	1·0	395		
30	2·45	1,100	2·65	1,300	1·05	410		
31			2·5	1,140	0·9	370		

MONTHLY DISCHARGE of Toby creek, near Athalmer, for 1912.

(Drainage area, 220 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
June	3,750	530	1,660	7·5	8·4	98,800
July	2,460	722	1,170	5·3	6·1	71,900
August	1,190	370	709	3·2	3·7	43,600
September	425	270	358	1·6	1·8	21,300

NOTE.—The accuracy of the drainage area, 220 square miles, is not guaranteed. No desirable maps could be obtained. The mean discharge for September was deduced from known discharges for September 1 to 13 and September 28. Toby creek froze up in 1912 at the end of October.
Accuracy, "B."

TRANQUILLE RIVER (230).

Tranquille river is about 30 miles long, varying in width from 15 to 50 feet, and in depth from 1 to 6 feet. It rises in township 24, range 19, west of 6th meridian, at an elevation of about 6,000 feet, and discharges into Kamloops lake, whose altitude is 1,125 feet. About 3 miles from the mouth, there is a canyon 100 feet wide, with steep granite banks. Just above the canyon the right fork of Tranquille river enters; it rises in lake du Bois at an elevation of 2,600 feet. The middle fork joins the Tranquille about 4 miles above the head of the canyon, one branch of which is known as Watching creek, and rises in Pass lake (3,300 feet). The main stream, fed by the snow of the Sil-Whoia-Kun mountain (6,030 feet), comes from Tranquille lake (4,800 feet). These lakes are difficult of access, and no storage has as yet been utilized, although if necessity arose it no doubt could be obtained. The drainage basin of Tranquille river is sparsely timbered in the lower reaches, but no information about the upper part of the stream could be obtained. It is probable, however, that it is well covered with timber, as is the upper part of the Jamieson creek basin near which it lies. There are two dams on Tranquille river, both of which have fallen into disuse. They were constructed several years ago by mining interests. The upper dam, on Watching creek, was 20 feet high; the lower, about 4 miles from the mouth, was about 6 feet in height.

The station on Tranquille river was established June 4, 1911, by C. G. Cline. The measuring section is located about 20 feet above Cooney's diversion dam, and one mile and a half above the mouth. This is an excellent section; the control is good, current uniform, banks high, and there is one permanent channel. The measurements are all made by wading. A standard vertical staff gauge is located 100 yards above the dam, and its datum is referred to three bench-marks.

The drainage area is about 230 square miles. The precipitation is only about 5 to 7 inches at the mouth, and 12 inches at the source.

DISCHARGE MEASUREMENTS of Tranquille River, 1½ miles from mouth, 1911-12.

Date	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec. ft.
July 4	C. G. Cline	1046	14	17·7	1·10	0·94	19·1
Sept. 11	"	1046	13	9·4	0·25	0·60	2·3
1912.							
Feb. 1	"	1046	12	15·4	0·5	.....	8·3*
Feb. 1	"	1046	12	15·4	0·5	.....	8·8*
Apr. 13	C. G. Cline, E. M. Dann	1046	11	15·2	1·2	0·96	17·8
May 7	E. M. Dann	1044	34	59·2	7·7	2·50	456·†
May 12	"	1044	36	74·5	7·7	2·70	576·†
May 25	"	1044	34	52·0	6·0	2·10	314·
June 1	"	1044	21	30·5	4·5	1·52	136·0
Aug. 2	H. J. E. Keyes	1057	13	10·3	2·0	0·88	21·0
Sept. 10	"	1057	18	19·2	1·7	1·01	33·0

*Ice cover.
†At high water section.

DAILY GAUGE HEIGHT AND DISCHARGE of Tranquille River, 1½ miles from mouth, for 1911.

Day.	JULY.		AUGUST.		SEPTEMBER.		OCTOBER.	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1.	.....	.....	0·7	4·0	0·57	1·7	0·7	4·0
2.	.....	.....	0·67	3·4	0·55	1·5	0·67	3·4
3.	.....	.....	0·65	3·0	0·6	2·0	0·67	3·4
4.	0·95	24	0·65	3·0	0·7	4·0	0·67	3·4
5.	0·95	24	0·65	3·0	0·67	3·4	0·67	3·4
6.	0·92	20	0·7	4·0	0·62	2·4	0·7	4·0
7.	0·92	20	0·82	12·0	0·65	3·0	0·7	4·0
8.	0·95	24	0·8	10·0	0·65	3·0	0·72	5·2
9.	0·97	28	0·75	7·0	0·62	2·4	0·72	5·2
10.	1·0	30	0·67	3·4	0·6	2·0	0·75	7·0
11.	1·02	33	0·70	4·0	0·6	2·0	0·75	7·0
12.	1·0	30	0·70	4·0	0·57	1·7	0·72	5·2
13.	0·95	24	0·67	3·4	0·72	5·2	0·72	5·2
14.	0·92	20	0·65	3·0	0·75	7·0	0·7	4·0
15.	0·9	18	0·65	3·0	0·75	7·0	0·7	4·0
16.	0·85	14	0·65	3·0	0·7	4·0	0·7	4·0
17.	0·82	12	0·62	2·4	0·7	4·0	0·75	7·0
18.	0·8	10	0·62	2·4	0·7	4·0	0·75	7·0
19.	0·82	12	0·6	2·0	0·7	4·0	0·72	5·2
20.	0·8	10	0·65	3·0	0·72	5·2	0·72	5·2
21.	0·8	10	0·65	3·0	0·72	5·2	0·72	5·2
22.	0·8	10	0·65	3·0	0·75	7·0	.....	.....
23.	0·75	7	0·65	3·0	0·75	7·0	.....	.....
24.	0·75	7	0·6	2·0	0·72	5·2	.....	.....
25.	0·75	7	0·6	2·0	0·7	4·0	.....	.....
26.	0·75	7	0·6	2·0	0·7	4·0	.....	.....
27.	0·72	5	0·57	1·7	0·7	4·0	.....	.....
28.	0·72	5	0·57	1·7	0·7	4·0	.....	.....
29.	0·7	4	0·55	1·5	0·7	4·0	.....	.....
30.	0·7	4	0·6	2·0	0·7	4·0	.....	.....
31.	0·7	4	0·57	1·7	.....	.....	.....	.....

MONTHLY DISCHARGE of Tranquille River, 1¼ miles from mouth, for 1911.

(Drainage area, 230 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
July	33	4	13·6	0·06	0·07	836	
August	12	1·5	3·5	0·015	0·017	215	
September	7	1·5	3·93	0·017	0·019	234	
October	7	3·4	4·9	0·021	0·024	301	
The period							8 to 10

NOTE.—Station was established July 4, 1911.
Accuracy, "A."

Daily Gauge Height and Discharge of Tranquille River, 1½ miles from month, for 1912.

Day.	March.		April.		May.		June.		July.		August.		September.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·8	10	1·92	252	1·6	155	1·0	30	0·9	18	.....	27
2			0·8	10	2·02	287	1·5	129	1·02	33	.....	18	.....	36
3			0·7	4	2·2	355	1·45	116	1·05	37	0·9	18	1·1	44
4			0·7	4	2·3	395	1·4	103	1·05	37	.....	16	.....	44
5			0·7	4	2·25	375	1·4	103	1·05	37	0·85	14	1·1	44
6			0·7	4	2·4	435	1·4	103	1·02	33	.....	12	.....	44
7			0·7	4	2·5	475	1·3	81	1·1	44	0·8	10	1·1	44
8			0·8	10	3·0	680	1·2	61	1·0	30	.....	14	.....	.....
9			0·9	18	3·1	720	1·2	61	1·0	30	0·9	18	.....	.....
10			0·9	18	2·8	600	1·15	52	0·97	26	.....	17	.....	.....
11			0·9	18	2·6	515	1·15	52	0·95	24	.....	16	.....	.....
12			0·9	18	2·7	560	1·2	61	0·92	20	0·87	16	.....	.....
13			0·95	24	2·75	580	1·2	61	0·9	18	.....	15	.....	.....
14			0·95	24	2·85	620	1·2	61	.....	18	0·85	14	.....	.....
15			1·0	30	2·9	640	1·22	65	0·9	18	.....	12	.....	.....
16			1·02	33	2·7	560	1·2	61	.....	14	0·8	10	.....	.....
17			1·05	37	2·5	475	1·15	52	0·8	10	.....	12	.....	.....
18			1·05	37	2·3	395	1·15	52	.....	10	.....	14	.....	.....
19			1·07	40	2·2	355	1·1	44	0·8	10	.....	16	.....	.....
20			1·1	44	2·2	355	1·05	37	.....	10	0·9	18	.....	.....
21			1·17	56	2·4	435	1·05	37	0·8	10	.....	17	.....	.....
22			1·25	71	2·35	415	1·0	30	.....	24	0·87	16	.....	.....
23			1·3	81	2·3	395	1·0	30	1·05	37	.....	13	.....	.....
24			1·32	85	2·3	395	0·97	26	.....	40	0·8	10	.....	.....
25			1·35	92	2·1	315	0·95	24	1·1	44	.....	10	.....	.....
26			1·37	96	2·1	315	0·92	20	.....	40	0·8	10	.....	.....
27			1·45	116	2·1	315	0·9	18	.....	35	.....	13	.....	.....
28			1·5	129	1·9	245	0·9	18	.....	30	.....	16	.....	.....
29	0·7	4	1·75	195	1·8	210	1·05	37	.....	26	0·9	18	.....	.....
30	0·8	10	1·9	245	1·7	180	0·95	24	.....	22	.....	18	.....	.....
31	0·8	10			1·7	180	.....	.....	0·9	18	0·9	18	.....	.....

MONTHLY DISCHARGE of Tranquille River, 1½ miles from mouth, for 1912.
(Drainage area, 230 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	245	4	51·9	0·23	0·26	3,090	
May	720	180	429	1·8	2·1	25,800	
June	135	18	59·1	0·26	0·29	3,520	
July	44	10	26·3	0·11	0·13	1,620	
August	18	10	14·7	0·07	0·08	904	
The period							10 to 12

NOTE.—Station maintained during irrigation season only.
Accuracy, "A."

TWAAL CREEK (206).

Twaal creek rises in the hills in the northwest boundary of township 18, range 25, west 6th meridian, at an elevation of 2,500 feet. It flows in a southeasterly direction for 12 miles, discharging into Thompson river 3 miles above Spences Bridge, at an elevation of 750 feet. It is a small stream about 5 feet wide, from 6 inches to 1 foot deep, flowing with a velocity of 0·5 feet to 1·5 feet per second. There are several falls of 10 feet on the stream, the valley is very narrow and the banks steep. A trail follows the creek practically to the source. The upper part of the valley broadens out a little, and in it there is some good agricultural land. This land is all included in Cook's Ferry Indian Reserve No. 4 and 6. Three hundred inches of water is recorded by Messrs. Moren and Curnow from Twaal creek to irrigate lots 23, 378 and 28 G. 1. Throughout the irrigation season about 4 c.f.s. of water reaches Mr. Moren's upper diversion. The ditches are long and the soil gravelly so there is generally a scarcity of water. The Indians on the reserve up the creek also have records, but of a later date, and at times they divert the creek over their land. Twaal creek is a very contentious irrigation stream.

The hydrographic station established in June, 1911, and maintained till October 1, 1911, showed that about 4 second-feet of water reached Moren's upper diversion. Miscellaneous measurements in 1912 showed the flow to be about the same.

DISCHARGE MEASUREMENTS of Twaal Creek above Moren's Diversion, for 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec	Feet.	Sec.-ft.
June 21	C. E. Richardson	1,048	6·7	2·2	1·5	0·59	3·4*
Sept. 17	" "	1,048	12·5	3·9	1·3	0·66	5·1*
June 21	" "	1,048	7·5	6·9	0·8		5·8†
1912.							
May 20	C. G. Cline	1,046	6·5	1·5	2·1		3·2*
June 27	B. Corbould	1,053	4·0	1·4	2·8		3·9*
July 19	"	1,053	4·3	1·5	3·1		4·6*
Aug. 9	"	1,044	7·3	2·1	2·1		4·5*

*Above Moren's Diversion.
†Above Indian Diversion.

GAUGE HEIGHTS AND DAILY DISCHARGE of Twaal Creek above Moren's Diversion, for 1911.

Day.	JUNE.		JULY.		AUGUST.		SEPTEMBER	
	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.	Gauge height.	Discharge.
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·6	3·6		3·6		4·8
2				3·6		3·6	0·65	4·8
3				3·6	0·6	3·6		4·8
4				3·6		3·7		4·8
5				3·6		3·8		4·8
6			0·6	3·6		4·0	0·65	4·8
7				3·6	0·62	4·2		4·8
8			0·6	3·6		3·9		4·8
9			0·6	3·6		3·7		4·8
10				3·6	0·6	3·6	0·65	4·8
11				3·6		3·8		4·8
12			0·6	3·6		4·0		4·8
13				3·6		4·2		4·8
14				3·6		4·4		4·8
15				3·6		4·6		4·8
16			0·6	3·6		4·8		4·8
17				3·6	0·65	4·8	0·65	4·8
18				3·6		4·8		5·0
19				3·6		4·8		5·2
20			0·6	3·6		4·8		5·4
21	0·6	3·6		3·6	0·65	4·8		5·7
22		2·9		3·6		4·8		5·9
23		2·3	0·6	3·6		4·8		6·2
24	0·5	1·6		3·6	0·65	4·8	0·7	6·4
25		2·1		3·6		4·8		6·1
26		2·6		3·6		4·8		5·9
27		3·1	0·6	3·6	0·65	4·8		5·6
28	0·6	3·6		3·6		4·8		5·4
29		3·6		3·6	0·65	4·8		5·2
30		3·6	0·6	3·6		4·8		4·9
31				3·6		4·8		

MONTHLY DISCHARGE of Twaal Creek, above Moren's Diversion, for 1911.

(Drainage area, 30 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
July	3·6	3·6	3·6	0·12	0·14	220
August	4·8	3·6	4·4	0·14	0·16	270
September	6·4	4·8	5·2	0·17	0·19	310

NOTE.—Station discontinued September 30, 1911. Accuracy "D." Curve is based on 2 measurements. See miscellaneous measurements made in 1912. Winter conditions exist for 3 months of the year.

Venables Creek (207).

Venables creek has its source at the foot of White mountain, north of Spences Bridge, at an elevation of 6,000 feet, and discharges into Thompson river, 6 miles north of Spences Bridge, at an elevation of 820 feet. It is part of the Thompson drainage; the drainage area, as estimated, is 13 square miles; of this, 10 square miles is above the gauge.

Venables creek is a small irrigation stream, lying between Oregon Jack and Twaal creeks. It has only a small watershed, and is dry most of the year. During the spring freshet, however, there is often a good discharge from White mountain; this water is stored in Venables lake, and is used for irrigation later in the season. The lake is a mile and a half long, half a mile wide, at an altitude of 2,230 feet. This provides a good reservoir, and it is possible to use all the freshet flow to advantage. There is probably considerable loss by seepage, however, because in the canyon below there is a spring which runs all the year round, and which is large enough for the Indians to irrigate with. Venables valley, in which the lake is situated, is about 6 miles long, and from half to a mile wide; it contains several thousand acres of good land, part of which can be irrigated from Venables lake and is being farmed to advantage. The main drawback is the storage of water in dry years, and the comparatively high altitude, 2,000 feet. The land above the lake cannot be irrigated by a gravity system, as the stream runs dry. There is also some good land at the mouth of the creek, held principally by Indians. Between this section and the valley, there is a deep canyon in which the creek bed falls 1,400 feet in two miles. There is rarely any water in this section of the stream, except where the spring rises; even the freshet water is held back by the dam on the lake. The original route of the Yale-Cariboo road was through the Venables valley, and the land was taken up at that time. Later, when the C.P.R. was built on the opposite side of Thompson river, the route was changed, and the valley was left isolated. Now, however, the C.N.R. is being constructed near the valley, and conditions may improve.

The river station on Venables creek was established May 6, 1912, by C. G. Cline. The measuring section is located in the Venables valley, 100 feet above the lake. This is a fairly good section, the control is good, the current uniform, the banks high, and there is one channel; the bed of the latter, however, is mud, and is subject to trampling by cattle. A standard staff gauge is located at the measuring section on the right bank.

Discharge Measurements of Venables Creek (207), above Venables Lake, 1912.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 6	C. G. Cline	1,046	[illegible]	1·0	0·6	2·48	[illegible]
" 17	"	1,046	3·0	0·9	0·8	2·59	0·7
June 20	C. G. Cline and B. Corbould					2·10	0·0

*Creek dry.

GAUGE HEIGHTS AND DAILY DISCHARGE of Venables Creek, above Venables Lake, for 1911.

Day.	MAY.		JUNE.		JULY.		AUGUST.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	.....	0·55	.....	0·47	.....	0·2	.....	0·0
2	.....	0·55	.....	0·46	2·3	0·3	2·1	0·0
3	.....	0·55	2·4	0·45	.....	0·35	.....	0·05
4	.....	0·55	.....	0·38	.....	0·40	.....	0·10
5	.....	0·55	.....	0·30	2·4	0·45	2·2	0·15
6	2·47	0·55	.....	0·23	.....	0·45	.....	0·15
7	.....	0·56	2·2	0·15	.....	0·45	.....	0·15
8	.....	0·57	.....	0·10	.....	0·45	.....	0·15
9	.....	0·58	.....	0·05	2·4	0·45	2·2	0·15
10	2·5	0·60	2·1	0·0	.....	0·43	.....	0·15
11	.....	0·59	.....	0·0	.....	0·41	.....	0·15
12	.....	0·59	.....	0·0	.....	0·40	2·2	0·15
13	2·49	0·58	.....	0·0	2·35	0·38	.....	0·18
14	.....	0·62	2·1	0·0	.....	0·35	.....	0·21
15	.....	0·66	.....	0·0·	.....	0·32	.....	0·24
16	.....	0·70	.....	0·0	2·3	0·30	.....	0·27
17	.....	0·73	2·1	0·0	.....	0·25	2·3	0·30
18	2·6	0·76	.....	0·0	.....	0·20	.....	0·30
19	.....	0·77	.....	0·0	2·2	0·15	.....	0·30
20	.....	0·78	.....	0·0	.....	0·19	2·3	0·30
21	2·62	0·79	.....	0·0	.....	0·23	.....	0·28
22	.....	0·85	2·1	0·0	.....	0·27	.....	0·26
23	2·7	0·92	.....	0·0	2·3	0·30	.....	0·24
24	.....	0·90	.....	0·0	.....	0·25	2·25	0·22
25	2·67	0·87	2·1	0·0	.....	0·20	.....	0·22
26	.....	0·81	.....	0·0	.....	0·20	2·25	0·22
27	2·6	0·76	.....	0·0	2·2	0·15	.....	0·20
28	.....	0·69	2·1	0·0	.....	0·10	.....	0·20
29	.....	0·62	.....	0·0	.....	0·05	.....	0·18
30	.....	0·55	.....	0·1	2·1	0·0	.....	0·17
31	2·42	0·48	.....	.....	.....	0·0	2·2	0·15

MONTHLY DISCHARGE of Venables Creek, above Venables Lake, for 1912.

(Drainage area, 10 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
May	0·92	0·48	0·67	0·07	0·08	41	.....
June	0·47	0·0	0·09	0·01	0·01	5	.....
July	0·45	0·0	0·28	0·03	0·03	17	.....
August	0·3	0·0	0·19	0·02	0·02	12	.....
The period	.....	.....	.....	.....	.....	.....	10

NOTE.—Station maintained during irrigation season only.
Accuracy, "C."

Viola Creek (124).

Viola creek flows into Coquitlam lake from the east in section 8, township 5, range 6, west of the 7th meridian. Its flow, added to that of the Coquitlam river as given by the gauging station above the lake, will give the amount of water available for use by the Vancouver Power Company. The other small streams which flow into the lake itself will probably provide sufficient water for the city of New Westminster.

The gauging station on the creek is in a flat about 300 yards from the mouth. The meter measurements are made by wading. The station was established on October 26, 1912, and gauge readings are being taken three times a week. During the season of 1913 sufficient meter measurements will be taken to develop the rating curve. The station is below the 30-foot contour, and when the lake is raised to the level the gauge will be flooded. If it is desired to continue the gaugings after that it will be necessary to go some distance farther up the stream to get a good station.

On October 26, 1912, the discharge was 258 c.f.s.

Warren Creek (305).

Warren creek has its source in the Spa hills, about 20 miles southwest of Salmon Arm, at an elevation of 4,000 feet and, flowing in a southwesterly direction, discharges into Salmon river, about a mile below the mouth of Bolean creek, at an elevation of about 1,700 feet. It is part of the Salmon-Shuswap lake, South Thompson drainage; the drainage area, as measured from the Geological Survey map, dated 1895, scale 2 miles to an inch, is 10 square miles. This is an irrigation stream situated at the easterly limit of the Dry Belt; the precipitation varies from 15 to 18 inches.

Warren creek is about 3 miles long; at high water it is 6 feet wide, 1 foot deep, and has a mean velocity of 3 feet per second; at low water the creek is very small, discharging less than half a second foot. The three records on the creek (under the name Ferris creek) total 420 miners inches (11. 7 c.f.s.) which is more than the flow of the creek, except during the month of May. But the recorded quantity of water is also greatly in excess of the amount required by the appurtenant lands. If the water were properly conserved, there would be sufficient to irrigate 500 acres in an average year. This might be done by storing water in Spanish lake, a small lake at the source of the stream. About 300 yards from the mouth, the creek has a fall of 75 feet which could be used for a small power development during May and June, but the flow of water is too small during the rest of the year to be of any service.

The river station on Warren creek was established May 22, 1911, by C. E. Richardson. The measuring section is located about a third of a mile from the mouth, 300 yards above a 40-foot water fall, about a quarter of a mile from the Armstrong-Grand Prairie wagon road. The measurements are all made by wading. This is an excellent section, the control is good, the banks high, the current uniform, and there is only one channel, with a permanent bed. A standard vertical staff gauge is located on the left bank of the stream about 20 feet above the measuring section. The datum of the gauge is referred to three bench-marks.

DISCHARGE MEASUREMENTS of Warren Creek, above Warren's Diversion, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
May 22	C. E. Richardson	1 048	6·0	3·6	3·1	1·00	11·2
May 23	"	1 048	7·2	3·7	2·9	0·96	10·7
May 23	C. G. Cline	1 046	6·0	6·5	1·2	0·96	8·1
May 23	W. M. Carlyle	1 044	7·5	4·8	2·0	0·96	9·9
May 22	"	1 044	9·0	7·7	1·3	1·00	10·0
June 16	"	1 044	8·0	4·0	0·6	0·61	2·4
July 11	"	1 044	8·5	4·3	0·6	0·64	2·6
July 25	"	1 044	4·5	2·5	0·3	0·50	0·7
1912.							
May 13	C. E. Richardson	1 048	6·0	5·7	3·3	1·23	18·6
July 16	"	1 048	5·2	2·5	0·7	0·58	1·8

DAILY GAUGE HEIGHT AND DISCHARGE of Warren Creek, above Warren's Diversion, for 1911.

Day.	May.		June.		July.		August.		September.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·80	5·8	0·55	1·5	0·45	0·6	0·40	0·3
2	0·80	5·8	0·80	5·8	0·55	1·5	0·42	0·4	0·42	0·4
3	0·80	5·8	0·80	5·8	0·55	1·5	0·40	0·3	0·45	0·6
4			0·78	5·4	0·52	1·2	0·40	0·3	0·45	0·6
5			0·75	4·7	0·50	1·0	0·40	0·3	0·42	0·4
6			0·72	4·1	0·50	1·0	0·45	0·6	0·42	0·4
7			0·70	3·7	0·60	2·1	0·50	1·0	0·41	0·4
8			0·68	3·3	0·66	3·0	0·45	0·6	0·40	0·3
9			0·68	3·3	0·66	3·0	0·42	0·4	0·40	0·3
10			0·65	2·9	0·66	3·0	0·42	0·4	0·40	0·3
11			0·65	2·9	0·64	2·7	0·42	0·4	0·40	0·3
12			0·65	2·9	0·62	2·4	0·42	0·4	0·40	0·3
13			0·65	2·9	0·58	1·9	0·42	0·4	0·48	0·9
14			0·62	2·4	0·50	1·0	0·42	0·4	0·45	0·6
15			0·60	2·1	0·50	1·0	0·40	0·3	0·45	0·6
16			0·60	2·1	0·50	1·0	0·40	0·3	0·44	0·6
17			0·55	1·5	0·48	·9	0·40	0·3	0·42	0·4
18			0·55	1·5	0·48	·9	0·45	0·6		
19			0·55	1·5	0·48	·9	0·45	0·6		
20			0·52	1·2	0·48	·9	0·45	0·6		
21			0·52	1·2	0·48	·9	0·44	0·6		
22	1·00	10·9	0·55	1·5	0·49	·9	0·45	0·6		
23	0·95	9·6	0·52	1·2	0·49	·9	0·45	0·6		
24	0·90	8·2	0·52	1·2	0·46	·7	0·42	0·4		
25	0·88	7·8	0·52	1·2	0·45	·6	0·42	0·4		
26	0·85	7·0	0·52	1·2	0·45	·6	0·42	0·4		
27	0·82	6·3	0·52	1·2	0·42	·4	0·42	0·4		
28	0·82	6·3	0·52	1·2	0·42	·4	0·40	0·3		
29	0·80	5·8	0·55	1·5	0·42	·4	0·40	0·3		
30	0·80	5·8	0·58	1·9	0·42	·4	0·40	0·3		
31	0·80	5·8			0·42	·4	0·40	0·3		

MONTHLY DISCHARGE of Warren Creek, above Warren's Diversion, for 1911.

(Drainage area, 10 square miles.)

Month.	Discharge in Second-Feet.				Run-Off.		Rainfall.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
June	5·8	1·2	2·6	·3	·3	160	
July	3·0	0·4	1·3	·1	·1	80	
August	1·0	0·3	0·4	·04	·05	25	
The period							15

NOTE.—Station discontinued on September 17 being past the irrigation season.
Accuracy, "A."

GAUGE HEIGHTS AND DAILY DISCHARGE of Warren Creek, above Warren's Diversion, for 1912.

Day.	April.		May.		June.		July.		August.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1	0·45	0·6	0·80	5·6	0·80	5·6	0·60	2·1		1·5
2	0·45	0·6	0·80	5·6	0·80	5·6	0·60	2·1	0·55	1·5
3	0·45	0·6	0·90	7·9	0·80	5·6		2·6		1·5
4	0·45	0·6	0·90	7·9	0·75	4·6		3·1	0·55	1·5
5	0·45	0·6	0·95	9·2		4·1		3·6		1·3
6	0·45	0·6	1·00	10·6	0·70	3·6		4·1	0·52	1·2
7	0·45	0·6	1·00	10·6	0·70	3·6	0·70	3·6		1·2
8	0·45	0·6	1·10	13·7	0·70	3·6	0·65	2·8	0·52	1·2
9	0·45	0·6	1·15	15·5	0·70	3·6	0·65	2·8		1·6
10	0·45	0·6	1·15	15·5	0·65	2·8		2·7	0·60	2·1
11	0·55	1·5	1·10	13·7		3·2		2·5		2·1
12	0·60	2·1		15·5	0·70	3·6		2·3	0·60	2·1
13	0·50	1·0	1·20	17·4	0·70	3·6	0·60	2·1		1·8
14	0·60	2·1	1·20	17·4	0·70	3·6	0·60	2·1	0·55	1·5
15	0·65	2·8	1·40	26·2	0·70	3·6		2·0		1·5
16	0·65	2·8	1·40	26·2		3·6		1·9	0·55	1·5
17	0·65	2·8	1·20	17·4	0·70	3·6		1·8		1·5
18		2·8	1·20	17·4	0·70	3·6		1·8	0·55	1·5
19	0·65	2·8	1·20	17·4	0·65	2·8		1·7		1·5
20	0·65	2·8	1·20	17·4	0·65	2·8		1·6	0·55	1·5
21	0·65	2·8	1·20	17·4	0·65	2·8	0·55	1·5		1·5
22	0·65	2·8	1·20	17·4	0·65	2·8		1·5	0·55	1·5
23	0·65	2·8	1·20	17·4	0·65	2·8	0·55	1·5		1·5
24	0·70	3·6	1·20	17·4	0·65	2·8		1·5	0·55	1·5
25	0·70	3·6	1·30	21·6	0·60	2·1	0·55	1·5	0·55	1·5
26		4·1	1·30	21·6	0·60	2·1		1·5		1·5
27	0·75	4·6	1·00	10·6		2·1	0·55	1·5	0·55	1·5
28		5·1	1·00	10·6	0·60	2·1		1·5		1·5
29	0·80	5·6	0·90	7·9	0·60	2·1	0·55	1·5	0·55	1·5
30	0·80	5·6		6·8		2·1		1·5		1·5
31			0·80	5·6			0·55	1·5		1·5

MONTHLY DISCHARGE of Warren Creek, above Warren's Diversion, for 1912.

(Drainage area, 10 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAINFALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	5·6	0·6	2·3	0·2	0·2	137	
May	26·2	5·6	14·3	1·4	1·6	879	
June	5·6	2·1	3·4	·3	·3	202	
July	4·1	1·6	2·1	·2	·2	129	
August	2·1	1·2	1·6	·2	·2	98	
The period							18

NOTE.—Station observed only during the irrigation season. The creek is frozen for four months during the winter, during which time the run-off is very small.

Accuracy, "A."

WITCH CREEK (258).

Witch creek has its source in Highland valley in section 1, township 18-23-6, at an elevation of 4,000 feet, and discharges into Guichon creek from the east, about 7 miles from Mamit lake, at an elevation of 3,300 feet. It is a part of the Guichon-Nicola-Thompson drainage; the drainage area, as measured from a Geological Survey map, dated 1895, scale 2 miles to an inch, is 41 square miles; 40 miles of this area is above the station. This is an irrigation stream, governed by the water records on Guichon creek below Mamit lake. The stream is in the heart of the Dry Belt; the summers are hot and dry, the winters long and cold; the annual precipitation is about 15 inches.

Witch creek rises in the range hills in Highland valley, its main feeder being Divide lake at an elevation of 3,960 feet. A mere trickle at low water, the stream is 20 feet wide, two feet deep, with a mean velocity of 3·5 feet at high water. There are several small Indian reserves along the creek, but there is no agriculture as the Indians only live there for a short time in the summer. Beaver dams and meadows serve to store the water, but it is necessary to blow up the dams to obtain water in the late summer. The creek is not important except as a tributary of Guichon creek, a very contentious irrigation stream.

The river station on Witch creek was established September 14, 1911, by W. M. Carlyle, though no data was obtained until April, 1912. The measuring section is located at the highway bridge on the road between Chartrand's ranch and Ashcroft, which crosses the stream about 1 mile from the Savona-Merritt road. A standard vertical staff gauge is located on the downstream side of the bridge. Measurements are made by wading, except at very high water, when cable measurements are taken.

DISCHARGE MEASUREMENTS of Witch Creek, near mouth, 1911-12.

Date.	Hydrographer.	Meter No.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge
1911.			Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.
Sept. 14..	W. M. Carlyle..	1044	3·8	2·0	0·34	0·54	0·7
1912.							
Apr. 27....	H. J. Keys.	1057	12·0	5·2	1·3	0·85	6·7
May 14....	"	1057	17·5	21·5	3·4	2·05	74·0
May 21....	"	1057	18·0	18·6	2·9	1·75	54·1
June 3....	"	1057	15·0	8·5	1·71	1·20	14·5
June 10...	"	1057	12·0	5·8	1·77	0·94	10·3
June 24...	"	1057	10·0	3·8	0·82	0·70	3·1
July 2....	"	1057	10·5	5·2	1·43	0·85	7·5
July 15....	"	1057	10·0	4·7	1·07	0·76	5·0
July 30....	"	1057	10·0	3·4	0·9	0·65	3·0
Sept. 3...	"	1057	10·0	5·9	1·4	0·93	7·1

GAUGE HEIGHTS AND DAILY DISCHARGE of Witch Creek, near mouth, for 1912.

Day.	APRIL.		MAY		JUNE		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.	
	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge	Gauge height.	Discharge
	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1			0·9	8·0		19·2		3·7		1·3	1·0	11·0		2·8
2	1·3	22·0		9·5	1·2	17·7		5·9	0·6	1·5		10·0	0·67	2·7
3		19·8	1·0	11·0		16·5	0·9	8·0		1·9		9·0		2·1
4	1·2	17·7		11·0		15·3		6·1	0·65	2·3	0·9	8·0	0·6	1·5
5		12·8	1·0	11·0	1·1	14·2	0·75	4·3		2·9		9·5		
6	0·9	8·0		12·6		12·2		5·8		1·7	1·0	11·0		
7		8·0	1·1	14·2	0·97	10·1	0·87	7·2	0·6	1·5		9·8		
8		8·0		23·3		10·1		6·4		1·5	0·92	8·6		
9	0·9	8·0	1·5	32·5	0·97	10·1		5·6	0·6	1·5		7·6		
10		9·5		34·1		9·6	0·77	4·8		7·1		6·6		
11		11·0	1·55	35·7		9·1		4·0	1·05	12·6	0·8	5·5		
12	1·05	12·6		41·1		8·6	0·7	3·2		11·1		5·5		
13		11·6	1·7	46·5	0·9	8·0		5·0		9·6	0·8	5·5		
14		10·6		61·3		8·0	0·85	6·7	0·9	8·0		4·6		
15	0·95	9·5	2·0	76·0	0·9	8·0		5·0		8·0	0·72	3·7		
16		8·2		81·5		8·0		3·3	0·9	8·0		3·5		
17		6·9	2·1	87·0	0·9	8·0	0·6	1·5		15·0		3·3		
18	0·8	5·5		71·0		6·7		1·5	1·3	22·0	0·7	3·2		
19		5·5	1·8	55·0	0·8	5·5	0·6	1·5		16·9		3·2		
20	0·8	5·5		55·0		5·5	1·1	14·2		11·8	0·7	3·2		
21		5·5		55·0	0·8	5·5		12·3	0·85	6·7		2·5		
22	0·8	5·5	1·8	55·0		5·5		10·4		6·1	0·62	1·8		
23		5·5		47·0	0·8	5·5		8·5	0·8	5·5		2·4		
24	0·8	5·5	1·6	39·0		4·2	0·85	6·7		6·1		3·0		
25		6·7		35·7		2·9		5·7	0·85	6·7	0·72	3·7		
26	0·9	8·0	1·5	32·5	0·6	1·5	0·77	4·8		6·7		3·4		
27		7·6		27·2		1·5		3·6		6·7	0·7	3·2		
28		7·2	1·3	22·0	0·6	1·5	0·65	2·3	0·85	6·7		3·2		
29	0·85	6·7		22·0		1·5		1·9		16·9	0·7	3·2		
30		7·4	1·3	22·0	0·6	1·5		1·5	1·4	27·0		3·0		
31				20·6			0·55	1·1		19·0				

MONTHLY DISCHARGE of Witch Creek, near mouth, for 1912.
(Drainage area, 40 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.		RAIN-FALL.
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.	Inches.
April	22·0	5·5	9·2	0·23	0·26	550	
May	87·0	8·0	37·3	0·93	1·08	2,300	
June	19·2	1·5	8·0	0·2	0·22	480	
July	14·2	1·1	5·2	0·13	0·15	320	
August	27·0	1·3	8·4	0·21	0·24	520	
September	11·0	1·8	5·4	0·135	0·15	320	
The period							12

NOTE.—Station was established on September 14, 1911, and one measurement taken on that date; discharge, 0·7 second-feet. Records were commenced on April 2, 1912, and continued to October 4, 1912. Gauge readings were taken only twice a week.
Accuracy, "A."

YOHO RIVER (415).

Yoho river has its source in Wapta ice fields, 20 miles north of Field, and flows in a south-by-southeasterly direction, discharging into Kicking Horse river, 5 miles east of Field. It is a rapid mountain stream, 20 miles long, varying in width from 40 feet to 150 feet, and in depth from 2 feet to 6 feet. The tributaries (going upstream) in ascending order are: Takakkak falls from the right, Little Yoho river from the left, and Twin falls from the left. The drainage area of the stream is 75 square miles. The annual precipitation is over 90 inches, of which from 40 inches to 50 inches is snow. The run-off depth in inches in 1912 exceeded 90 inches, but no run-off factor can be obtained, as it is known that the glaciers are receding. The winter conditions are severe (—40 F.) while the summers are hot, with considerable rain.

The scenic beauty of Yoho valley is well known. Thousands of tourists annually drive up the valley to see the famous Takakkak falls, where the water is seen to fall 1,250 feet. Many of these ride up the valley to see the beautiful Twin falls and the various glaciers and snowfields.

Two small power developments are possible. A head of 80 feet may be obtained in 300 yards from the mouth upstream, and, by damming, a small pondage is practicable. By placing the power site along Kicking Horse river below the mouth of the Yoho a head of 120 feet is obtainable. About 2 miles from the mouth there is a canyon 5 miles long, 50 feet wide at the bottom, and 300 feet at the top. The walls are of a solid granite formation. The fall is 400 feet in the 5 miles, but a head of 300 feet could be obtained by constructing a high narrow dam at the foot of the canyon. There is a good power site at the foot of the canyon on the east bank. Any power would have frazil ice to contend with, extremely severe winter conditions to meet, and a good flow for only the summer months.

On June 5, 1912, a metering was made by C. E. Richardson, and a discharge of 127 c.f.s. obtained.

A gauge was established on Yoho river on June 5, 1912, by C. E. Richardson, but it was carried away by the heavy freshet at the end of June. The discharge of Yoho river, however, was determined from the difference between the daily discharges of Kicking Horse river at Field and at No. 2 tunnel, *i.e.*, below and above the mouth of the Yoho. The discharges, as deduced, are here given.

DAILY DISCHARGE of Yoho River, near mouth, for 1912.

Day.	JULY.	AUGUST.	SEPTEMBER.	OCTOBER.
	Discharge.	Discharge.	Discharge.	Discharge.
	Sec.-ft.	Sec.-ft.	Sec.-ft.	Sec.-ft.
1	1,630	2,330	445	140
2	1,770	2,310	350	125
3	1,280	2,590	310	132
4	1,410	2,730	265	140
5	1,560	2,350	255	132
6	1,530	1,480	235	125
7	1,360	1,710	245	125
8	1,220	1,960	245	125
9	1,450	2,350	245	110
10	1,280	2,020	265	110
11	1,660	1,720	330	110
12	1,450	1,410	420	95
13	1,590	1,270	400	95
14	900	1,590	310	95
15	1,470	1,740	295	105
16	1,460	1,530	295	105
17	1,680	1,030	250	105
18	1,820	960	215	105
19	1,790	1,040	175	105
20	1,870	1,250	155	90
21	1,730	1,580	165	90
22	2,050	1,890	165	90
23	1,870	2,450	135	90
24	1,790	2,390	138	90
25	1,710	3,220	130	90
26	1,300	2,230	130	90
27	1,160	1,800	122	100
28	1,260	1,300	125	100
29	1,900	820	125	90
30	2,390	610	125	90
31	2,450	500	.....	90

MONTHLY DISCHARGE of Yoho River, near mouth, for 1912.

(Drainage area, 75 square miles.)

Month.	DISCHARGE IN SECOND-FEET.				RUN-OFF.	
	Maximum	Minimum	Mean.	Per sq. mile.	Depth in inches on Drainage area.	Total in acre-feet.
June	3,800	100	1,580	21·1	23·5	94,000
July	2,450	900	1,610	21·5	24·8	99,000
August	3,390	500	1,780	23·7	27·4	109,000
September	445	125	285	3·0	3·3	14,000
October	140	90	106	1·4	1·6	6,500

NOTE.—The above results are deduced by taking the difference between the discharges at the gauging station at Field (below the mouth of the Yoho) and the discharges at the gauging station at No. 2 tunnel (above the mouth of the Yoho river). Estimated minimum flow (during the winter)=50 c.f.s.

Accuracy, "B."

PART III

MISCELLANEOUS DISCHARGE MEASUREMENTS

MISCELLANEOUS DISCHARGE MEASUREMENTS.

NOTE.—Streams marked with an asterisk are those on which stations have been established, but daily discharges are not yet computed.

Date.	Name of Stream.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.	Remarks.
		Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.	
Sept. 13, 1912	*Akolkolex river.	33	176	3·7	5·3	655·	
May 8, 1912	Alkali creek.....	7·5	5·4	2·1	0·4	11·3	A tributary of Cherry creek.
May 18, 1912.	"	5·2	2·1	1·8	−0·1	3·8	
May 29, 1912.	"	1·1	0·2	5·7	−0·15	1·3	
July 20, 1912.	"	1·0	0·1	2·0	−0·5	0·1	
July 11, 1912.	Bear creek.....	18	20	1·2	3·3	25·	A tributary of Adams river.
July 15, 1912.	Beard creek.	6	3·4	1·3	0·66	4·3	A tributary of upper Columbia river.
Oct. 21, 1912.	*Belknap creek..	33	51	0·7	1·6	33·7	
May 10, 1911.	Blue-earth creek.	6	3·0	0·45	0·38	1·4	
May 18, 1911.	"	7	4·4	0·9	0·52	4·0	
June 2, 1911.	"	5	1·8	1·1	0·42	1·9	
Aug. 20, 1912.	"	3	1·0	1·2		1·2	
Nov. 3, 1911.	*Boulder creek.	28	24	0·5	10·8	12·6	A tributary of Jones creek.
Sept. 18, 1912	"	30	24	0·6	10·75	13·4	
Oct. 19, 1912.	*Brandt creek.	30	25	1·5	2·02	36·6	
Jan. 4, 1912.	Bristo creek...	9	3·1	1·4		4·4	
June 9, 1912	Cache creek...	10	3·6	0·8		2·8	Above lower diversion.
June 9, 1911..	"					1·7	Irrigation ditch on Semlin ranch.
Aug. 3, 1912.	*Canyon creek....	56	58	3·5	1·80	205	A tributary of upper Columbia river.
July 15, 1912	Cartwright creek.	8	5·7	0·6	0·9	3·2	Also called Carbonate creek.
June 26, 1912.	Cherry creek.....	7·5	2·8	0·9		2·5	Below Cornwall's diversion. See also station on Cherry creek.
Oct. 27, 1912.	*Coquitlam river.	80·	200	1·6	2·55	322·	Above Coquitlam lake.
June 18, 1912.	Colley creek	3·5	1·1	2·1		2·4	Tributary of upper Hat creek.
July 12, 1912.	"	3·3	1·2	2·6		3·9	
Aug. 1, 1912.	"	2·7	0·8	1·3		1·0	
Aug. 20, 1912.	"	2·8	0·8	2·0		1·7	
Oct. 10, 1911.	Chehalis river.				1·11	205	
Oct. 17, 1911.	"				1·74	526	
Oct. 20, 1911.	"				1·56	412	Just below outlet of Chehalis lake.
Oct. 22, 1911.	"				1·41	323	
Oct. 24, 1911.	"				1·26	271	Measurements made
Oct. 26, 1911.	"				1·18	235	by R. G. Swan, B.A.
Oct. 30, 1911.	"				1·04	183	Sc.
Nov. 1, 1911.	"				0·90	134	
Nov. 3, 1911.	"				0·86	128	
Nov. 3, 1911	"	73	127	1·1	0·86	133	By C. G. Cline, Ry. Belt Hydrographic Survey.
May 30, 1912.	Dairy creek....	3·0	1·1	0·8		1·1	Beaton's ditch.
May 19, 1912	Duffy creek....	1·1	0·2	0·4	0·4	0·1	
June 24, 1912	Edwards creek.	2·0	1·0	1·3		1·3	Irrigation ditch.
June 25, 1911.	"	11·0	6·3	0·3		1·8	At Devick's lower diversion.
June 24, 1911.	"	2·0	0·3	0·8		0·2	Diversion to Sullivan creek.

MISCELLANEOUS DISCHARGE MEASUREMENTS—*Continued.*

Date.	Name of Stream.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.	Remarks.
		Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.	
July 13, 1911.	Eight-mile creek	1·5	0·45	1·6		0·7	Near Ashcroft, flowing into Thompson river.
June 5, 1912.	*Emerald river	22	24	2·1	2·01	49·6	
June 26, 1912.	"	36	62	3·9	2·92	237	
July 1, 1912.	"	36	45	3·2	2·5	144	
Aug. 5, 1912	"	37	46	3·4	2·58	156	
Aug. 14, 1912	"	37	32	3·3	2·31	106	
Oct. 2, 1912.	"	20	19	1·7	1·85	31	
Oct. 8, 1911.	Falls creek	4·0	2·1	1·6	0·61	3·4	
June 20, 1911.	Guichon creek (Leighton's diversion to Tunkwa lake).	6·5	4·7	0·7		3·4	
May 10, 1912.	" "	4·0	2·6	11·4		30·1	At intake } Difference shows loss in 2 miles of ditch.
May 10, 1912.	" "	6·5	6·4	2·6		16·5	At outlet }
Sept. 16, 1912	" "	4·0	0·9	6·8		6·2	At outlet.
June 26, 1912.						0	Ditch closed.
July 22, 1912.	Guichon creek	24	26	1·3		34·5	Above diversions to Lower Nicola.
Aug. 12, 1912	" "	23	24	1·1		26·2	Lower Nicola. See station on Guichon creek at mouth to obtain amount of water used by subtracting the discharges.
Oct. 26, 1912.	*Gold creek	34	47	2·6	3·70	124	Tributary of Coquitlam river.
June 6, 1911.	Graves creek	4	1·0	2·1		2·1	
June 21, 1911.	Gordon creek	3·0	0·4	1·0		0·4	
May 24, 1912.	" "	4·0	2·0	1·2		2·5	Max. of 6 c. f. s. on May 17, 1912.
June 5, 1912.	" "	3·5	0·75	1·2		0·9	
June 21, 1912	" "	4·0	1·2	0·7		0·8	
July 9, 1912.	" "		0·4	1·4		0·6	
June 1, 1911.	Hat creek (at Hat Creek ranch, lower station)	32	30	4·4	2·15	135	Station abandoned 1911.
July 22, 1911.	Hat creek (at Hat Creek ranch, lower station)	6	2·8	0·3	0·58	0·9	
Sept. 28, 1911	Hat creek (at Hat Creek ranch, lower station)	15	9·2	1·6	0·96	14·8	
Sept. 30, 1911	Hat creek (at Hat Creek ranch, lower station)	15	9·4	1·6	0·96	15·3	
Aug. 19, 1912	Hat creek (in Hammond's ditch)	4	3·1	1·8		5·9	Discharge into reservoir.
Aug. 19, 1912.	Hat creek (in Hammond's ditch)				0·89	7·2	At intake. Difference between this and former shows loss in ditch.
Aug. 20, 1912	Hat creek (in Hammond's ditch	4·5	1·8	2·6		4·6	At outlet of reservoir in Oregon Jack divide. Shows amount of water flowing down Oregon Jack creek.
May 9, 1911.	Hat creek (at Pocock's)	18	10	0·9	1·1	9·5	

MISCELLANEOUS DISCHARGE MEASUREMENTS—*Continued.*

Date.	Name of Stream.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.	Remarks.
		Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.	
May 16, 1911.	Hat creek (at Pocock's)	24	15	2·5	1·73	37·4	
July 19, 1911	Hat creek (below King creek)	12	7·0	0·2		1·4	
Oct. 19, 1912.	*Hixon creek	18	35	2·0	2·00	71·5	
July 15, 1912.	Hogranch creek	7	3·8	2·7	0·8	10·5	
June 5, 1912.	Horse creek	7	4·4	1·0	0·65	4·4	
June 23, 1912	" "	8	5·0	2·4	0·90	12·1	
July 9, 1912	" "	8	5·4	2·4	0·91	12·8	
Sept. 16, 1912	*Incomappleux river	96	570	2·6		1,520·	
Nov. 3, 1911.	*Jones creek	59	96	0·54	0·55	51·8	Gaugings of Jones creek have been taken regularly by Messrs Anderson and Warden, C.E., during 1911 and 1912.
Sept. 18, 1912	" "	60	104	0·83	0·90	87·1	
June 4, 1912.	Kicking Horse river (at Palliser)	110	310	3·0	2·1	920	
June 27, 1912	Kicking Horse river (at Palliser)	150	840	7·2	5·77	6070·	
Aug. 15, 1912	Kicking Horse river (at Palliser)	125	410	5·3	3·42	2140	
June 18, 1912	King creek	2·5	0·6	0·8		....0·4	
July 11, 1912	"	3·2	0·9	1·2		...1·1	
Aug. 1, 1912.	"	2·5	0·5	0·5		...0·3	
June 21, 1911	Lane Creek	7·0	3·5	0·9	0·80	3·1	
Aug. 20, 1911	" "	1·0	0·2	0·4	0·27	0·1	
Oct. 7, 1911.	" "	1·8	0·4	0·5	0·28	0·2	
May 24, 1912.	" "	9·5	6·3	3·0	1·2	19·3	
June 5, 1912.	" "	2·0	0·6	12·6	...	7·6	
July 9, 1912.	" "	2·5	1·5	2·6	0·8	3·9	
June 13, 1912.	Lloyd creek	5·	3·8	1·0	1·1	3·9	
Aug. 4, 1912.	" "	6·	2·9	0·8	0·92	2·4	
Aug. 23, 1912	Louis creek	38	47	1·4	.....	68·0	Above Armour's diversion.
June 5, 1911.	Maiden creek	4·0	2·0	3·0	...	6·0	
June 6, 1911.	" "	2·5	0·8	1·7	...	1·3	
July 15, 1911.	" "	2·0	0·7	2·0	.....	1·4	
July 15, 1911.	" "	3·0	2·7	1·0	....	2·7	
Sept. 28, 1911	" "	5·0	3·2	0·6		1·9	
Aug. 2, 1912	" "	5·3	4·6	1·0	...	4·5	
Aug. 28, 1912	" "	6·5	4·7	0·9	..	4·4	
Oct. 31, 1912.	*Meslilooet river (upper station)	70	120	1·6	2·26	188·	
Aug. 21, 1912	McGillivray creek	7·5	7·0	0·8	...	5·5	A tributary of Louis creek.
July 15, 1912.	McKeeman creek	12	6·	0·75		4·5	
May 20, 1911.	Monte creek	..				19·0	Below Bostock diversion.
May 25 1911	" "					41·5	Above diversion to Summit lake.
Sept. 15, 1911	Murray creek					9·8	
Oct. 24, 1911	" "					10·5	
July 23, 1912.	*Nahatlatch river (lower station)	80·	432	4·4	3·75	1,920·	
Nov. 28, 1912	*Nahatlatch river (lower station)	60	352	2·5	2·20	891·	
July 15, 1912.	Nelson creek	5	2·6	0·8	2·6	2·0	A tributary of upper Columbia river.
Sept. 23, 1911	Nikaia creek	5·8	4·0	1·1		4·4	
June 1, 1912.	" "	6·0	5·0	1·6		8·1	
July 27, 1912.	" "	3·5	1·0	0·7		0·6	
Oct. 20, 1912.	*Norton creek	9	12	0·6	2·53	7·6	
Oct. 5, 1911.	Palmers creek	4·5	1·6	1·1	1·0	1·7	
May 19, 1912.	" "	14	12	3·1	2·0	36·3	
June 14, 1912.	" "	9	9	1·6		14·6	
June 13, 1912.	*Paul creek	9	9	1·1	0·95	9·5	Below Pinantan lake.
Aug. 4, 1912.	" "	7	1·9	0·8	0·65	1·5	" "

MISCELLANEOUS DISCHARGE MEASUREMENTS—*Continued.*

Date.	Name of Stream.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.	Remarks.
		Feet.	Sq. ft.	Ft. per sec.	Feet.	Sec.-ft.	
Mar. 26, 1912	Peterson creek	5·7	2·4	1·1	0·2	2·7	Victoria St., Kamloops.
Mar. 26, 1912	" "	6·5	2·9	2·5	0·3	7·3	
Mar. 26, 1912	" "	16	7·1	4·6	0·63	32·4	
Mar. 26, 1912	" "	12·4	7·8	6·7	0·8	52·3	
						80·	Maximum at 5 p.m.
May 11, 1912.	Quenville creek	15	14	3·5	1·0	50·2	
May 22, 1912.	" "	12	12	1·7	0·2	19·5	
June 10, 1912.	" "	4·5	2·6	1·2	−1·1	3·1	
July 13, 1912.	" "		4·0	0·8		3·2	
May 26, 1911.	Robbins creek	7·0	2·7	0·7		1·8	Above Albert Duck's meadow.
Nov. 3, 1912.	*Rushton creek	32	54	1·2	2·18	64·	
Aug. 24, 1911	Salmon river	21	10·6	0·4		4·6	Half mile above Woods ranch.
Sept. 16, 1912	Salmon creek	38	32	1·8		58·	Near Beaton, upper Arrow lake.
Aug. 28, 1912	Scottie Creek	2·1	1·1	2·0		2·1	Hunters' diversion.
Aug. 22, 1911	Silver creek	8	3·6	1·0	0·73	3·5	Tributary of Salmon river near Salmon Arm
Aug. 9, 1912..	*Silver Pitt creek	65	104	2·4	1·5	250	
Sept. 16, 1911	Skuhun creek	11	10	0·6		5·5	
May 30, 1911.	South Thompson river at Kamloops	500	9,700	2·2		21,900	
May 30, 1911.	South Thompson river at Kamloops	500	9,600	2·2		21,100	
Nov. 2, 1911.	Statlu creek	20	131	0·3	1·46	40·	
Oct. 14, 1911.	Stave river	250	831	2·4	1·45	2,020	
Oct. 15, 1911.	" "	250	1,043	3·5	2·30	3,620	
Oct. 19, 1911.	" "	250	1,195	4·1	2·80	4,860	
Oct. 17, 1911.	" "				2·50	3,655	Weir method.
Oct. 16, 1911.	" "				2·30	3,470	Slope method.
Nov. 22, 1911	" "	205	4,570	2·1	4·50	9,480	
May 9, 1912..	Three-mile creek	15·5	16·6	2·5		41·5	Below Leighton's ranch on Kamloops-Savona road.
May 30, 1912.	" "	7	7	2·14		14·9	Below Leighton's ranch on Kamloops-Savona road.
July 26, 1912.	" "	9	4·5	1·34		6·1	Below Leighton's ranch on Kamloops-Savona road.
May 10, 1912.	" "	12	4·4	1·4		6·1	West branch (including water from Leighton's ditch from Guichon creek.)
May 24, 1912.	" "	6	2·8	0·7		2·0	
July 2, 1912..	" "	5	2·8	0·6		1·6	
July 27, 1912.	" "	6	1·6	0·75		1·2	
July 27, 1912.	" "					0·6	East branch.
Sept. 11, 1911	Tranquille river	2·0	0·5	1·3		0·7	Irrigation ditch.
July 4, 1911..	" "	2·5	1·2	1·6		2·0	" "
Sept. 10, 1912	" "	26	21	1·6		33·8	At foot of canyon.
June, 21 1911.	Twaal creek	7·5	6·9	0·8		5·8	Above Indians' diversion.
May 20, 1912.	" "	6·5	1·5	2·1	0·62	3·2	Above Moren's diversion
June 27, 1912.	" "	4·0	1·4	2·8		3·9	" " "
July 19, 1912.	" "	4·3	1·5	3·1	0·45	4·6	
Aug. 9, 1912..	" "	7·3	2·1	2·1	0·42	4·5	
July 15, 1912.	Twenty-eight Mile creek	3·5	1·6	0·4	3·5	0·6	Tributary of upper Columbia river.
Oct. 26, 1912.	*Viola creek	51	58	4·5	1·80	258·	Tributary of Coquitlam lake.
June 5, 1912..	Washout creek	4	2·1	0·5	0·79	1·1	
June 23, 1912.	" "	5	2·8	0·6	0·83	1·8	
July 9, 1912.	" "	11	4·2	1·0	1·01	4·1	
July 15, 1912.	Warmspring creek	7	1·8	1·1		2·0	
Oct. 6, 1911..	White creek	9	4·8	0·4		1·8	
June 5, 1912.	Yoho river	53	50	2·6		127	See also river station.
Oct. 20, 1912.	*Young creek	11	11	1·1	2·0	11·4	Tributary of Mesliloet river.

PART IV

HYDROGRAPHIC GAZETTEER

OF

LAKES, RIVERS, CREEKS AND OTHER SOURCES OF WATER SUPPLY IN AND ADJOINING THE RAILWAY BELT OF BRITISH COLUMBIA.

HYDROGRAPHIC GAZETTEER OF LAKES, RIVERS, CREEKS AND OTHER SOURCES OF WATER SUPPLY IN AND ADJOINING THE RAILWAY BELT OF BRITISH COLUMBIA.

This list is not guaranteed to be complete, but is compiled from all available sources of information, Government and private maps, lists of water records and local knowledge. Most of the names are those adopted by the Geographic Board of Canada; others are merely local names, and an attempt has been made to locate and identify the features affixing the most suitable name for future permanent reference. There are also a number of local names of unidentified streams from the lists of water records, which have not been included in this list.

Adams River.—An important river flowing from Adams lake into Shuswap lake in township 22-12-6, near Chase, B.C. The river is only about 7 miles long, and falls about 190 feet. Important timber interests, and one of the best undeveloped water-powers in the interior of British Columbia. *See* hydrographic data of river station on Adams river. (South Thompson drainage.)

Adams Lake.—A lake about 40 miles long and with a superficial area of 60 square miles. Empties into Adams river. Important timber interests. Good reservoir for power purposes. (Adams-South Thompson drainage.)

Agate Creek.—A small tributary of Nicola river from the west in the 'Dry Belt,' in township 15-23-6. Might be used for irrigation, but there is little development in the vicinity. (Nicola-Thompson drainage.)

Agnes Creek.—A small tributary of Paul creek in township 20-15-6, in the 'Dry Belt.' Water not used. Probably same creek as Lloyd creek. (Paul-North Thompson drainage.)

Aikens Creek.—Local name for small unidentified irrigation stream.

Akolkolex River.—(Sometimes called Isaac creek). Has its source in the Selkirks in township 23-28-5, is 18 miles long and discharges into Columbia river from the east, about 16 miles below Revelstoke. The drainage area is 65 square miles. The water is used for logging, and there are good water-power possibilities.

On September 13, 1912, the discharge was 665 c.f.s. The estimated maximum flow in the middle of the summer is about 2,000 c.f.s. The estimated minimum flow is about 50 c.f.s. during the severe winter.

About 2 miles from the mouth there is a fall of 335 feet; a total head of nearly 400 feet could be obtained, the rocky canyon being only from 30 feet to 40 feet wide. There is no good natural storage available. This waterfall is worthy of future investigation. (Columbia drainage.)

Albert Canyon Springs.—Hot springs about half mile south of Albert Canyon railway station. (Illecillewaet-Columbia drainage.)

Albert Creek.—A mountain stream flowing into Illecillewaet river from the south, in township 25-28-5, near Albert Canyon railway station. No important interests (Illecillewaet-Columbia drainage.)

Alder Creek.—A small mountain stream flowing into Beaver river from the west, in township 29-25-5. Water not used. (Beaver river-Columbia drainage.)

Alexander Creek.—Probably a small unimportant tributary of Jamieson creek, in Tranquille plateau, 20 miles north of Kamloops.

Alkali Creek.—A small irrigation tributary of Cherry creek in township 19-19-6. *See* miscellaneous measurements thereon.

Alkali Creek.—A small tributary of South Thompson river from the north, in township 19-15-6. Generally dry. (South Thompson drainage.)

Allen Creek.—A small tributary of Bonaparte river from the west, near the north limit of the Railway Belt. Irrigation only. (Bonaparte-Thompson drainage.)

American Creek.—A small tributary of Fraser river from the west, in township 5-26-6, 4 miles north of Hope. No important interests. (Fraser drainage.)

Amiskwi River.—A tributary of Kicking Horse river from the north. It rises in the main Rockies at Amiskwi pass (some 17 miles northwest of Field) at an elevation of about 6,000 feet. It flows for about 16 miles in a general southerly direction and discharges into Kicking Horse river 3 miles west of Field. It is a rapid mountain stream about 40 feet wide, and varies in depth from 2 to 5 feet. Its maximum flow occurs in June, from the melting mountain snow and glaciers, and is estimated at 900 c.f.s. The estimated minimum flow is 20 c.f.s. in February. The winters are cold and severe (–40 F.). The annual precipitation is about 35 to 40 inches, of which 60 per cent is snow. The principal interest is lumbering. Power possibilities are small. The drainage area is 80 square miles. (Kicking Horse-Upper Columbia drainage.)

Anderson Creek.—A small stream, in township 19, E.C.M., flowing from the west into Sumas lake. No important interests. (Sumas-Fraser drainage.)

Anderson Creek.—A small creek in the Dry Belt, in township 20-26-6, flowing from the west into Hat creek. (Hat creek-Bonaparte-Thompson drainage.)

Anderson Creek.—A small tributary of Campbell creek, in township 18-17-6, in the Dry Belt. (Campbell creek-South Thompson drainage.)

Anderson River.—A tributary of Fraser river from the east, in township 10-26-6. Possible small power development. For hydrographic data see river station on Anderson river. (Fraser drainage.)

Andrew Lake.—A small lake at the head-waters of Cherry creek, in township 19-19-6. Suitable for a small reservoir for irrigation purposes. (Cherry creek-Thompson drainage.)

Anstey Arm.—The most northeasterly arm of Shuswap lake, in townships 24-7-6 and 25-7-6.

Anstey River.—Flows into the north end of Anstey arm of Shuswap lake, in township 25-7-6. (Shuswap lake-South Thompson drainage.)

Antler Lake.—A very small lake on the plateau west of Mamit lake, in township 16-21-6. No important interests.

Armstrong Creek.—Local name of unidentified creek in the Revelstoke district.

Arrow Lake.—A broadening of Columbia river, some 30 miles south of Revelstoke. Outside the Railway Belt. (Columbia drainage.)

Ashton Creek.—A small tributary of Shuswap river from the north, in township 18-8-6. No important interests. (Shuswap-South Thompson drainage.)

Asulkan Creek.—A small glacial stream tributary to Illecillewaet river, at Glacier, B.C. (Illecillewaet-Columbia drainage.)

Atchalitch Creek.—A small tributary of Fraser river from the south, near Sumas, in township 23, E.C.M. (Fraser drainage.)

Bachelor Creek.—A mountain torrent, tributary to Gold creek from the south, in township 30-27-5 (Gold creek-Columbia drainage.)

Badger Creek.—Local name of a small unidentified irrigation stream in the Dry Belt.

Badlands Lake.—Local name of a small unidentified lake, about 27 miles east of Kamloops.

Bain Creek.—A small tributary of Incomappleux river, in township 25-26-5. Mining interests only. (Incomappleux-Columbia drainage.)

Baines Creek.—A small irrigation stream tributary to North Thompson river from the west. Probably outside the Railway Belt.

Baird Creek.—A small mountain stream flowing into North Fork of Spillimacheen river from the east, in township 26-24-5. No important interests or users. (Spillimacheen-Upper Columbia drainage.)

Barnes Lake.—A small lake tributary to Barnes creek in township 20-24-6. (Thompson drainage.)

Barnes Creek.—A small but contentious irrigation stream flowing into Thompson river from the southeast, about 4 miles east of Ashcroft in township 20-24-6. For hydrographic data see the river station on Barnes creek. (Thompson drainage.)

Barricade Creek.—A small tributary of Deadman river from the west in township 23-22-6. The water is used for irrigation purposes. (Deadman-Thompson drainage.)

Battle Creek.—A glacial stream tributary to Incomappleux river from the east, in township 24-26-5. (Incomappleux-Columbia drainage.)

Bear Creek.—A small tributary of Harrison lake, in township 6-28-6. (Harrison-Fraser drainage.)

Bear Creek.—A mountain stream rising near Rogers pass and flowing into Beaver river from the east, in township 27-25-5. The C.P.R. has several water records for railway purposes. (Beaver-Columbia drainage.)

Bear Creek.—A tributary of Adams river from the west in township 22-12-6; it is 8 miles long, 10 to 15 feet wide and has a mean summer discharge of 25 c.f.s. Its drainage area is 25 square miles. Timber interests are important and the Adams River Lumber Company proposes to divert the waters (20 c.f.s.) from the creek for fluming logs to Little Shuswap lake. (Adams-South Thompson drainage.)

Beard Creek.—A small irrigation stream, tributary to Upper Columbia river from the east, in township 24-19-5. On July 15, 1912, the discharge was 4.3 c.f.s. which is about the mean summer flow. (Upper Columbia drainage.)

Beaver Lake.—A small lake on the plateau north of Kamloops lake, six miles from Battle Bluff.

Beaver River.—Rises in Duncan pass, at an elevation of 4,600 feet, and flows northerly for 35 miles, emptying into Columbia river about 1 mile west of Beavermouth railway station. There is no agriculture in the valley, but some good timber is still uncut. There are no pronounced falls or rapids in the upper part of the river, but near the mouth there is the Natural Arch (or Gateway)) close to the railway. There is a fall in the river of about 80 feet in a distance of 3,000 feet, the river being only from 20 to 40 feet wide, with rocky banks. At the head of the rapids the C.P.R. rail is only 15 feet above the high-water mark, and at the foot it is 25 feet above high water. A dam at the head of the rapids would give excellent pondage.

Any development is restricted by the proximity of the present grade of the railway.

The precipitation, in this part of the Selkirks, ranges from 50 inches to 70 inches, mostly snowfall. The winter conditions are severe. In the summer the days are hot and the nights are cool. The estimated maximum flow, in June, July or August, is 3,000 c.f.s. The estimated minimum flow during the winter is about 50 c.f.s.

The drainage area of the Beaver river is 400 square miles. (Columbia drainage.)

Beaver Creek.—A small tributary of the Fraser river in township 14, R.C.M. Unimportant stream. (Fraser drainage.)

Beaverfoot River.—Rises in a low pass near the source of the Kootenay river, about 20 miles south of the C.P.R., and, flowing northerly through a valley nearly a mile wide, empties into the Kicking Horse river, near Leanchoil station and just above the Wapta falls. The Beaverfoot river is navigable for about 18 miles. Ice river is its largest tributary.

The drainage area of the Beaverfoot river is 140 square miles. The annual precipitation is probably from 30 inches to 35 inches, with heavy snowfall on the mountains. The winter conditions are severe, and the summers hot.

The estimated maximum discharge in June, 1,200 c.f.s., and the minimum discharge in the winter is about 25 c.f.s. (Kicking Horse-Columbia drainage.)

Beavertail River.—Now called Amiskwi river.

Bedwell Bay.—Part of the North arm of Burrard inlet, a tidal bay of the Pacific.

Belknap Creek.—A small tributary of Hixon creek (a tributary of Mesliloet river from the east) in township 6-7-7. Timber and small industrial power. The discharge on October 21, 1912, was 34 c.f.s. (Mesliloet drainage.)

Belknap Lake.—A small lake at the source of Belknap creek in township 6-7-7; suitable for storage. (Mesliloet drainage.)

Benedict Creek.—A tributary of Bachelor creek from the south, in township 30-27-5; it is a rapid mountain stream of little or no importance. (Bachelor-Gold-Columbia drainage.)

Bertrand Creek.—A small unimportant stream in township 13, E.C.M. (Fraser drainage.)

Big Creek.—A small stream flowing southerly into the northeast arm, Arrow lakes; small power development possible. (Columbia drainage.)

Big Eddy Creek.—A small stream in township 26-2-6, near Revelstoke. (Columbia drainage.)

Big Fish Lake.—A lake about one mile long, being the headwaters of Greenstone creek. Elevation, 4,800 feet; of importance in connection with storage for irrigation purposes. (Greenstone-Meadow-Guichon-Nicola drainage.)

Big Gulch.—Probably Indian Garden creek, or a branch of it; in township 20-21-6; irrigation. (Thompson drainage.)

Big Lake.—Now called Tunkwa lake.

Blackwater Creek.—A tributary of Bluewater creek, 3 miles from its mouth, in township 30-24-5; the creek is sluggish, 10 miles long, 15 to 20 feet wide and 2 feet deep. (Bluewater-Columbia drainage.)

Blackwater Lake.—A small lake, 1 mile long, near the head of Blackwater creek, in township 30-25-5. (Blackwater-Bluewater-Columbia drainage.)

Blaeberry River.—A large tributary of Columbia river from the northeast, 10 miles northwest of Golden. For complete description and hydrographic data see River Station on Blaeberry river. (Columbia drainage.)

Blair Creek.—A small tributary of Bolean creek in township 18-12-6. (Bolean-Salmon-Shuswap-Thompson drainage.)

Blue-Earth Creek.—A small trbutary of Hat creek in township 19-26-6. It has a maximum flow of about 4 c.f.s. in the month of May; (Hat Creek-Bonaparte-Thompson drainage.)

Blue-Earth Lake.—Is situated at the head of Blue-earth creek in the southeast corner of township 19-26-6. These are really two small lakes, with a difference in elevation of 5·7 feet. The area of the two lakes at their present water level is 45 acres, but at the 20-foot contour (*i.e.*, at the height of the old broken dam at the outlet of the lake), 74 acres. The capacity of the reservoir at the 20-foot contour is 1,100

acre-feet. Twaal creek divide at the easterly end of Blue-earth lake is 26 feet above the lake. The drainage area of Blue-earth lake is about 7 square miles. (Hat-Bonaparte Thompson drainage.)

Bluewater Creek.—A tributary of Columbia river from the north, 3 miles west of Donald in township 29-23-5; about 10 miles long, 150 feet wide and from 2 to 3 feet deep.

Bole Creek.—A small unimportant stream in the New Westminster district. (Fraser drainage.)

Bolean Creek.—(Sometimes called Six-mile creek), a tributary of Salmon river from the north in township 18-12-6, about 10 miles east of Grand Prairie. Bolean creek is just at the easterly limit of the Dry Belt. For complete hydrographic data see River Station on Bolean creek. (Salmon-Shuswap drainage.)

Bonaparate River.—A large tributary of the Thompson river from the north at Ashcroft in township 20-24-6; important irrigation and power interests. For complete hydrographic data see River Station on Bonaparte river. (Thompson drainage.)

Boston Bar Creek.—A small tributary of Coquihalla river in township 5-25-6. (Coquihalla-Fraser drainage.)

Botanie Creek.—A contentious irrigation stream flowing into Thompson river from the north in township 15-26-6, about 3 miles east of Lytton. For hydrographic data see River Station on Botanie creek. (Thompson drainage.)

Botanie Lake.—A lake of about 60 acres at the head of Botanie creek in Botanie Indian Reserve No. 15; suitable for reservoir for irrigation. (Botanie-Thompson drainage.)

Boulder Creek.—A small tributary of Chehalis river from the west in township 4-30-6. (Chehalis-Harrison-Fraser drainage.)

Boulder Creek.—A tributary of Jones creek near Jones lake in township 3-27-6; of interest in connection with the proposed power development of Jones lake. Detailed hydrographic data have been gathered by Messrs. Anderson and Warden, civil engineers, Vancouver, and check measurements have been made by the Railway Belt Hydrographic Survey. (Jones creek-Fraser drainage.)

Boulder creek.—A small tributary of Kicking Horse river from the east, near Emerald railway station, in township 29-19-5. (Kicking Horse-Columbia drainage.)

Boyd Creek.—A small tributary of Incomappleux river from the east, in township 22-26-5; timber interests and possibly small industrial power. (Incomappleux-Columbia drainage.)

Brandt Creek.—A small tributary of Mesliloet river from the east in township 6-7-7. Timber interests and small industrial power. Discharge on October 19, 1912, was 37 c.f.s. (Mesliloet drainage.)

Brush Creek.—(Sometimes called Elk creek.) A small tributary of Shuswap river from the north in township 18-8-6, 5 miles east of Enderby. (Shuswap-Thompson drainage.)

Brewery Creek.—A small stream flowing into Columbia river at Revelstoke.

Bridal Veil Falls.—Near Pitt lake.

Bridge Creek.—A small tributary of the Illecillewaet from the north near Revelstoke; city of Revelstoke water supply. (Illecillewaet-Columbia drainage.)

Brigade Lake.—A small lake in section 32, township 17-17-6, flowing into Campbell creek. (Campbell-South Thompson drainage.)

Bristo Creek.—A small stream flowing into Sumas lake from the west in section 27, township 19, E.C.M.; small industrial power and domestic uses. On January 4, 1912, the discharge was 4·3 c.f.s. (Sumas-Fraser drainage.)

Brousseau Creek and Lake.—A small tributary of Barricade creek in township 23-23-6. (Barricade-Deadman-Thompson drainage.)

Bryant Creek.—A tributary of Beaver river near Cutbank, probably either Cedar creek or Surprise creek. (Beaver-Columbia drainage.)

Buce Creek.—A small irrigation stream flowing into Buce lake in township 19-15-6.

Buce Lake.—A small lake in section 28, township 19-15-6, used for a storage reservoir for irrigation purposes; a greater portion of the water being diverted from Robbins Creek via Buce creek. (South Thompson drainage.)

Bugaboo River.—Is a tributary of the Columbia river from the west, about 40 miles north of Golden, B.C., and about 3 miles above the Spillimacheen river. It has its source in the Selkirk mountains at an elevation of from 6,000 feet to 9,000 feet. The drainage area is about 190 square miles.

Bugaboo river is a mountain torrent. At the highway bridge, about one mile from its mouth, it is about 60 feet wide at high water, and has a mean velocity of 6 feet per second. At low water it is 23 feet wide, and has a mean velocity of 2 feet per second.

At present, lumbering is the only interest on the river. Industrial power is a possibility. Two miles from the mouth, a canyon begins. This canyon is 1 mile long, and in that distance there is a fall of 220 feet (aneroid measurements). At the head of the canyon there is a fall of 60 feet.

For hydrographic data see River Station on Bugaboo river. (Drainage-Upper Columbia.)

Bullard Creek.—A small tributary of the Incomappleux river from the west near the south boundary of township 23-26-5. (Incomappleux-Columbia drainage.)

Bullet Creek.—A small tributary of Fraser river from the west, about 15 miles north of Lytton. (Fraser drainage.)

Buntzen Lake.—A small lake in township 39, W.C.M., used for storage purposes in connection with power development by the Vancouver Power Co. Area is 500 acres. Drainage area is 7 square miles. Elevation, 400 feet. Complete hydrographic data have been gathered by that company. (Burrard Inlet drainage.)

Burrard Inlet.—An arm of the Pacific, near Vancouver.

Bush Creek.—A tributary of Adams lake from the west, in township 23-13-6. (Adams-South Thompson drainage.)

Bush Lake.—Two small lakes in township 32-26-5 in the flat near the mouth of Bush river. (Columbia drainage.)

Bush River.—A large tributary of Columbia river entering from the east in township 32-26-5. Bush river is about 20 miles long to its forks. It is navigable almost to the forks, where there is a fall 6 feet high. The north fork is navigable for several miles, but the south fork has numerous falls and rapids. Bush river, at its mouth, is about 150 feet wide and from 3 to 5 feet deep. It has an estimated maximum discharge in July of 5,000 to 7,000 c.f.s., and a minimum discharge during severe winters of 60 c.f.s.

The precipitation is about 40 inches to 60 inches, mostly snowfall. The river is frozen for four months in the year. (Columbia drainage.)

Butter Creek.—A small stream in section 8, township 10-29-6.

Cabin Creek.—A small creek flowing into Columbia river from the west, in township 27-22-5, just below Golden. (Columbia drainage.)

Cache Creek.—A tributary of Bonaparte river from the east, in township 21-24-6; an important irrigation stream. For hydrographic data see River Station on Cache creek. (Bonaparte-Thompson drainage.)

Cahilty Creek.—A tributary of Louis creek from the east, in township 23-15-6; some water used for irrigation; small industrial power possible. For hydrographic data see River Station on Cahilty creek. (Louis-North Thompson drainage.)

Callahan Creek.—Now called Chatter creek.

Calling Lake.—A small lake (elevation 4,920) in township 17-23-6 at the head of Inkikuh creek. (Fraser drainage.)

Campbell Creek.—A contentious irrigation stream emptying into South Thompson river from the south, 10 miles east of Kamloops. For hydrographic data see River Station on Campbell creek. (South Thompson drainage.)

Campbell Lake.—At the head of the east Fork of Campbell creek, in township 18-16-6; a storage reservoir for irrigation purposes. (Campbell-South Thompson drainage.)

Campbell River.—A small stream flowing into Semiamu bay, in township 1, W. C.M.

Camp Lake.—A small lake on the north side of the Thompson river, 27 miles east of Kamloops. (South Thompson drainage.)

Canoe Creek.—A tributary of Salmon Arm from the south, in township 21-9-6; municipal water supply for the city of Salmon Arm. For hydrographic data see River Station on Canoe creek. (Shuswap Lake-South Thompson drainage.)

Canyon Creek.—Is a mountain stream rising in the Dogtooth range of the Selkirks and flowing into the Columbia river from the west, 7 miles south of Golden. The creek is about 15 miles long and from 15 feet to 50 feet wide. About 1 mile from the mouth there is a canyon 4 miles long in which the creek falls 850 feet (measured by aneroid). At the foot of the canyon the creek is 25 feet wide. The Columbia River Lumber Co. has a small dam at the foot of the canyon. Small industrial power could be developed at great expense. There are some important timber interests up the creek. Drainage area is 62 square miles. The precipitation varies from 14 inches at the mouth to 40 inches in the Selkirks. On August 3, 1912, the discharge was 205 c.f.s. The estimated maximum discharge early in July is 500 c.f.s. The estimated minimum flow during the severe winter is 15 c.f.s. (Upper Columbia drainage.)

Canyon Creek.—A small tributary of Jordan river in township 24-2-6, near Revelstoke. (Jordan-Columbia drainage.)

Canyon Creek.—A small tributary of Hefferly lake, in township 22-16-6. (Hefferly-North Thompson drainage.)

Carbonate Creek.—Now called Cartwright creek.

Cariboo Creek.—A small mountain stream flowing into Illecillewaet river from the north, in township 26-27-5. (Illecillewaet-Columbia drainage.)

Carnes Creek.—A tributary of Columbia river from the east at the north limit of the Railway Belt north of Revelstoke; timber, mining and small power. (Columbia drainage.)

Cartwright Creek.—A small tributary of Columbia river from the east, 17 miles south of Golden, in township 25-20-5. Also called Carbonate creek. Water is used for irrigation. On July 15, 1912, the discharge was 3 c.f.s., which is about the mean summer flow. (Upper Columbia drainage.)

Cascade Bay.—An arm of Harrison lake in township 5-28-6. (Harrison-Fraser drainage.)

Cascade Creek.—A small tributary of Stave river from the east in township 4-3-7. (Stave-Fraser drainage.)

Castle Creek.—A small stream in township 22-11-6 flowing into Shuswap lake from the south, near Notch hill. (Shuswap lake-South Thompson drainage.)

Cataract Creek.—A small mountain stream tributary to Kicking Horse river, from the south, in township 28-17-5. (Kicking Horse-Columbia drainage.)

Cathedral Creek.—A small tributary of the Kicking Horse from the south, 5 miles east of Field; small industrial power developed by Mount Stephen Mining Syndicate. (Kicking Horse-Columbia drainage.)

Cattle Creek.—A small tributary of Hat creek from the south in township 22-26-6. (Hat-Bonaparte-Thompson drainage.)

Cedar Creek.—A small mountain stream flowing into Beaver river from the west, in township 28-25-5.

Cedar Creek.—A small tributary of Upper Columbia river from the east at the south limit of the Railway Belt, in township 23-18-5.

Cedar Creek.—A small stream near Notch hill, in township 22-11-6. (Shuswap lake-South Thompson drainage.)

Celista Creek.—A tributary of Seymour Arm of Shuswap lake from the north in township 26-8-6. (Shuswap lake-South Thompson drainage.)

Charcoal Creek.—A tributary of Chase creek from the east, in township 19-12-6. (Chase-South Thompson drainage.)

Chartrand Creek.—A small irrigation stream flowing into Guichon creek from the east in township 18-21-6. For hydrographic data see River Station on Chartrand creek. (Guichon-Nicola-Thompson drainage.)

Chase Creek.—A tributary of South Thompson river from the south in township 21-13-6. Irrigation, power and municipal water supply. For hydrographic data see River Station on Chase creek. (South Thompson drainage.)

Chatter Creek.—A small tributary of Bush river from the north, in township 32-25-5. Sometimes called Callahan creek. (Bush-Columbia drainage.)

Chawuthen Creek.—A very small tributary of Fraser river from the south, in township 5-27-6. (Fraser drainage.)

Cheam Lake.—A small lake on the south side of Fraser river, in township 3-28-6.

Chehalis Lake.—An important broadening of Chehalis river, in township 5-1-7 and 6-1-7. Good reservoir.

Chehalis River.—A tributary of Harrison river from the north, in township 4-30-6; important timber and power interests. For hydrographic data see River Station on Chehalis river. Hydrographic investigations by the Vancouver Power Co. have also been made. (Harrison-Fraser drainage.)

Cherry Creek.—An important and contentious irrigation stream flowing into Kamloops lake from the south, in township 20-20-6. For hydrographic data see River Station on Cherry creek. (Thompson drainage.)

Chilliwack lake.—A large lake about 25 miles long at the head of Chilliwack river, in township 1-26-6.

Chilliwack River.—A large tributary of Sumas lake, in township 22, E.C.M. The river now enters Sumas lake via the channel of Vedder creek, having been diverted some years ago from its original bed to the Fraser via the old Luckakuck channel. The control of this river is important in connection with the large Sumas Dyking Project; timber interests and possible power. For hydrographic data see River Station on Chilliwack river. (Sumas-Fraser drainage.)

Christian Creek.—Small tributary of Louis creek from the west in township 22-15-6. (Louis-North Thompson drainage.)

Chuloewaku Creek.—A very small tributary of Fraser river from the west above Lytton, in township 16-27-6. (Fraser drainage.)

Chum Creek.—A small stream flowing into South Thompson river from the south, in township 22-12-6. (South Thompson drainage.)

Chum Lake.—A small lake at the head of Chum creek, in township 21-12-6. (Chum-South Thompson drainage.)

Chuwhels Lake.—A small lake at the head of Cherry creek, in township 18-19-6; storage reservoir for irrigation purposes. (Cherry-Thompson drainage.)

Cinquefoil Creek.—A small tributary of Rough creek in township 18-28-6. Outside the Railway Belt. (Rough-Fraser drainage.)

Cisco Creek.—A small tributary of Fraser river, in township 14-27-6. (Fraser drainage.)

Clanwilliam Lake.—A small lake in Eagle pass, emptying into Eagle river, in township 23-3-6. (Eagle-Shuswap lake-Thompson drainage.)

Clear Creek.—A tributary of Silver creek, in township 8-29-6. (Silver-Harrison lake-Fraser drainage.)

Cold Creek.—A small tributary of Paul Creek in Kamloops Indian Reserve. (Paul-North Thompson drainage.)

Coldspring Creek.—A small tributary of Thompson river from the east, in township 18-24-6.

Coldwater River.—A tributary of Nicola river from the south at Merritt. Source of river only in Railway belt. (Nicola-Thompson drainage.) Maximum flow for 1912 (estimated), 1,800 second-feet on May 21. Minimum flow for 1912 (estimated), 25 second-feet on September 30.

Colley Creek.—A small tributary of Hat creek from the west, in township 19-26-6; irrigation. See miscellaneous measurements on Colley creek. (Hat-Bonaparte-Thompson drainage.)

Columbia River.—One of the largest and best known rivers in British Columbia. *Vide* complete description of Columbia river.

Comedy Creek.—A tributary of Six-mile creek, in township 30-26-5. (Six-mile-Beaver-Columbia drainage.)

Cooke Creek.—A tributary of Shuswap river from the north, in township 19-6-6. (Shuswap-Thompson drainage.)

Copper Creek.—A tributary of Kamloops lake from the north, in township 21-20-6. Used for irrigation. (Thompson drainage.)

Copper Creek.—A tributary of Spillimacheen, Upper Columbia drainage.

Coquihalla River.—A tributary of Fraser river from the east at Hope, in township 5-26-6. Possible power developments. For hydrographic data see River Station on Coquihalla river. (Fraser drainage.)

Coquitlam Lake.—An important lake used for storage reservoir by the Vancouver Power Co., the water being diverted by a tunnel (maximum capacity, 1,350 c.f.s.) 2 miles long, to Buntzen lake. Lake also used by city of New Westminster for civic water supply. Hydraulic earth-fill dam 60 feet high constructed by the Vancouver Power Co. Lake is 7 miles long; area is 2,330 acres. The drainage area is 105 square miles. Precipitation is about 150 inches per annum.

Coquitlam River.—A tributary of Fraser river, in township 38, W.C.M. (Fraser drainage.)

Cornwall Creek.—A small irrigation stream flowing into Thompson river from the west in township 20-24-6. For hydrographic data see River Station on Cornwall creek.

Cornwall Lake.—A small lake on Cornwall creek, in township 21-25-6.

Cornwall Lake.—A small storage lake near the headwaters of Cherry creek, in township 19-19-6.

Cottonwood Lake.—A broadening in Maria slough (of Fraser river) in township 3-28-6 and 4-28-6. (Fraser drainage.)

Cougar Lake.—A tiny lake on the plateau west of Guichon creek, in township 16-21-6. (Guichon-Nicola drainage.)

Cougar Creek.—A small mountain stream flowing into Illecillewaet river from the north in township 26-26-5. The creek flows through the Nakimu Caves. (Illecillewaet-Columbia drainage.)

Cowan Creek.—Local name of small stream flowing into the Illecillewaet from the north, in township 24-1-6. City of Revelstoke water supply. (Illecillewaet-Columbia drainage.)

Craigellachie Creek.—A tributary of Eagle river from the north, in township 23-6-6. (Eagle-Shuswap Lake-Thompson drainage.)

Cranberry Creek.—A tributary of Upper Arrow lake from the west near Arrowhead; mostly outside the Railway Belt. (Columbia drainage.)

Crazy Creek.—A tributary of Eagle river from the north at Taft, in township 23-5-6. Small power development. (Eagle-Shuswap Lake-Thompson drainage.)

Criss Creek.—An irrigation stream flowing into Deadman river from the east, in township 22-22-6. For hydrographic data see River Station on Criss creek. (Deadman-Thompson drainage.)

Cronkrite Creek.—A small tributary of the Upper Columbia river from the east, 20 miles south of Golden. The water is used for irrigation. The maximum discharge is not more than 5 c.f.s., and the stream generally dries up in the late summer. (Upper Columbia drainage.)

Crown Lake.—A small lake in Marble canyon, in township 21-27-6, flowing into Pavilion lake, thence to Fraser river. (Fraser drainage.)

Cultus Lake.—A mountain lake, 3 miles long, flowing into Sweltzer river, in township 22, E.C.M. (Sweltzer-Chilliwack-Fraser drainage.)

Cultus Lake.—A small lake at the head of a branch of Deadman river, in township 22-22-6. Of little or no importance.

Currie Creek.—Also called Bolean creek. (Q.V.)

Cypress Lake.—A small lake flowing into Stave lake from the east, in township 5-2-7. (Stave-Fraser drainage.)

Dairy Creek.—A small irrigation stream, a tributary of the North Thompson river from the west, in township 21-17-6. Now called Gordon creek. (North Thompson drainage.)

Dairy Creek.—A small irrigation stream flowing into Cherry creek, in township 20-19-6. For hydrographic data see River Station on Dairy creek. (Cherry-Thompson drainage.)

Dairy Lakes.—Two small lakes at the head of Dairy creek, in township 20-19-6. (Dairy-Cherry-Thompson drainage.)

Davis Creek.—Now called Fortunes creek.

Deadman River.—An important irrigation stream flowing from the north into Thompson river, in section 36, township 20-22-6. Deadman river supplies the water

for the Barnes Estate at Walhachin. For hydrographic data see River Station on Deadman river. (Thompson drainage.)

Deadman Lake.—(Also called Snowhoost lake.) Just outside the northerly limit of the Railway Belt; 3 miles long, area 350 acres; storage dam 20 feet high; capacity of reservoir, 7,000 acre-feet. (Deadman-Thompson drainage.)

Debeck Creek.—A small stream flowing into Pitt lake from the west, in township 6-5-7.

Dennett Lake.—A small storage lake at the head of Gilley or Munroe creek.

Deep Creek.—Now called Otter river in Okanagan valley.

Deep Creek.—Now called Moulton creek.

Deer Creek.—A small tributary of Jamieson creek.

Deer Lake.—A small lake in township 5-28-6 at Ruby creek pass.

Disdero Lake.—A small lake in section 3, township 19-15-6 flowing into Robbins creek. (Robbins-Monte-Thompson drainage.)

Disappointment Lake.—A small lake near the head-waters of Coquitlam river, in township 7-6-7. (Coquitlam-Fraser drainage.)

Divide Lake.—Small lake at the head of Witch creek, in township 18-23-6. (Witch-Guichon-Nicola drainage.)

Dodd's Creek.—Now called Beard creek.

Dominick Lake.—A small lake flowing into Three-mile creek, in township 18-20-6; possible storage for irrigation. (Three-mile-Thompson drainage.)

Don Lake.—A small storage lake at the head of Young creek. (Brandt-Mesliloet drainage.)

Donald Creek.—A small stream flowing into the Columbia river from the south near Donald. (Columbia drainage.)

Douglas Creek.—A tributary of Nahatlatch river from the south, in township 12-27-6. (Nahatlatch-Fraser drainage.)

Downie Creek.—A tributary of Columbia river from the east, 50 miles north of Revelstoke; timber and mining; the source only is in the Railway Belt. (Columbia drainage.)

Drained Lake.—A small lake in township 21-18-6.

Dropping Water Creek.—A small irrigation stream flowing into Campbell creek, in township 17-17-6. (Campbell-South Thompson drainage.)

Dry Creek.—A small stream flowing into the South Thompson river, in township 19-14-6. Generally dry. (South Thompson drainage.) There are also numerous other streams called Dry creek which have not been identified.

Du Bois Lake.—A small lake draining into Tranquille river, in township 21-18-6. (Tranquille-Thompson drainage.)

Duchesnay Lake.—A small lake in Yoho valley, in township 29-18-5. (Yoho-Kicking Horse-Columbia drainage.)

Duffy Creek.—A small irrigation stream flowing into Kamloops lake from the south, in township 20-20-6. For hydrographic data see River Station on Duffy creek. (Thompson drainage.)

Duffy Lake.—A small lake suitable for storage purposes at the head of Duffy creek, in township 19-20-6.

Duncan River.—Rises in township 24-24-5, near the south limit of the Railway Belt and flows south into Lardeau river and Kootenay lake.

Dunville Creek.—A small stream flowing into Fraser river, in township 2-29-6. (Fraser drainage.)

Eagle River.—Forty miles long, rising in Eagle pass and flowing westerly, discharges into Shuswap lake at Sicamous. For hydrographic data see River Station on Eagle river. (Shuswap lake-Thompson drainage.)

Eagle Creek.—That part of Chehalis river above Chehalis lake.

Edith Lake.—A small lake at the headwaters of Peterson creek, in section 36 township 18-18-6. (Peterson-South Thompson drainage.)

Edwards Creek.—The north fork of Hefferly creek in township 22-16-6; used for irrigation. For hydrographic data see River Station on Edwards creek. (Hefferly-North Thompson drainage.)

Eight-mile Creek.—A small stream flowing into Thompson river in township 18-24-6. Now called Pukaist creek.

Eight-mile Creek.—A small irrigation stream flowing into Thompson river from the north in township 21-23-6. In June 13, 1911, the discharge was 0.7 c.f.s. (Thompson drainage.)

Elk Creek.—A small tributary of Fraser river, in township 26, E. C. M. (Fraser drainage.)

Elm Creek.—A very small stream in township 17-19-6.

Emerald Lake.—A lake of great scenic beauty at the head of Emerald river, 7 miles from Field.

Emerald River.—A small mountain stream, 10 miles long, rising in Emerald lake and flowing in a southwesterly direction, discharging into Kicking Horse river, 2 miles west of Field. For hydrographic data see miscellaneous measurements on Emerald river. (Kicking Horse-Columbia drainage.)

Emory Creek.—A small tributary of Fraser river from the west, in township 6-26-6; small power possibilities. (Fall of 1,150 feet in 3 miles). Discharge of 25 c.f.s. on December 9, 1912. (Fraser drainage.)

Ensign Creek.—A small mountain stream flowing into Blaeberry river from the east, in township 31-20-5. (Blaeberry-Columbia drainage.)

Erroch Lake.—A small lake in township 24, E.C.M., flowing into Nicomen slough, thence into Fraser river. (Fraser drainage.)

Essell Creek.—A small irrigation stream flowing from Summit lake into Salmon river at Grand Prairie, in township 17-13-6. For hydrographic data see River Station on Essell creek. (Salmon-Shuswap lake-Thompson drainage.)

Eureka Lake.—A small storage lake for irrigation purposes in the district south of Kamloops.

Eureka Creek.—A small tributary of Pitt river in township 5-4-7. (Pitt-Fraser drainage.)

Face Lake.—A lake about 1 mile long (elevation 4,840 feet) in township 18-20-6, flowing into Big Fish lake, thence into Greenstone creek. It is proposed to use this lake as a storage reservoir for irrigation purposes, diverting the water into Cherry creek watershed, but the drainage area is so small that it is doubtful if the quantity of water available would justify this proposal. (Greenstone-Meadow-Guichon-Nicola drainage.)

Fadear Creek.—A tributary of Louis creek from the east, in township 24-15-6. (Louis-North Thompson drainage.)

Falls Creek.—A small tributary of the Shuswap river from the north in township 19-7-6. Small power development possible. On October 8, 1911, the discharge was 3·4 c.f.s. (Shuswap-Thompson drainage.)

Ferguson Lake.—A small lake near the head-waters of Three-mile creek, in township 19-20-6.

Ferris Creek.—(Now called Warren creek, in township 17-12-6.)

Fifteen-mile Creek.—A small tributary of Upper Columbia river from the west, 15 miles south of Golden. (Upper Columbia drainage.)

Finney Lake.—A lake draining into Limestone creek, thence into Hat creek. The lake is situated in section 2, township 21-27-6. (Hat-Bonaparte-Thompson drainage.)

Fish Creek.—A small tributary of Campbell creek from the east, in township 17-17-6. (Campbell-South Thompson drainage.)

Fish Creek.—Now called Incomappleux river. (Q.V.)

Fish Lake.—(Also called Trout lake), a fishing resort about 20 miles south of Kamloops, in township 17-19-6. Elevation, 4,100 feet. (Meadow-Guichon-Nicola drainage.)

Fish Lake.—A small lake in section 5, township 18-16-6, and draining into Fish creek, thence into Campbell. (Fish-Campbell-South Thompson drainage.)

Five-mile Creek.—Now called Pimainus creek.

Flat Creek.—A small mountain stream flowing into Illecillewaet river from the south, in township 26-27-5. (Illecillewaet-Columbia drainage.)

Float Creek.—A small mountain stream flowing into Ottertail river, in township 27-18-5. (Ottertail-Kicking Horse-Columbia drainage.)

Fortunes Creek.—A tributary of Shuswap river from the south at Enderby, in township 18-9-6; municipal water supply and lighting plant for the town of Armstrong. For hydrographic data see River Station on Fortunes creek. Also called Davis creek. (Shuswap-South Thompson drainage.)

Fraser Creek.—A small stream flowing into Stump lake, in township 16-17-6. (Nicola-Thompson drainage.)

Fraser Creek.—A small tributary of Beaverfoot river, in township 25-19-5. (Beaverfoot-Kicking Horse-Columbia drainage.)

Fraser River.—One of the largest and best known rivers in British Columbia.

Freeze Creek.—A small tributary of Incomappleux river, in township 24-26-5. (Incomappleux-Columbia drainage.)

French Ned's Creek.—(Now called Ned's creek, in township 19-14-6.)

Frisby Creek.—A tributary of Columbia river from the west at the north limit of the Railway Belt, north of Revelstoke, in township 27-2-6. (Columbia drainage.)

Frisken Lake.—A small storage lake in township 16-16-6, flowing into Fraser creek, thence into Stump lake. (Fraser-Stump lake-Nicola drainage.)

Frog Creek.—(Also called Wap river.) Rises in the mountains south of Three Valley railway station and flows southerly into Mabel lake. (Mabel lake-Shuswap-South Thompson drainage.)

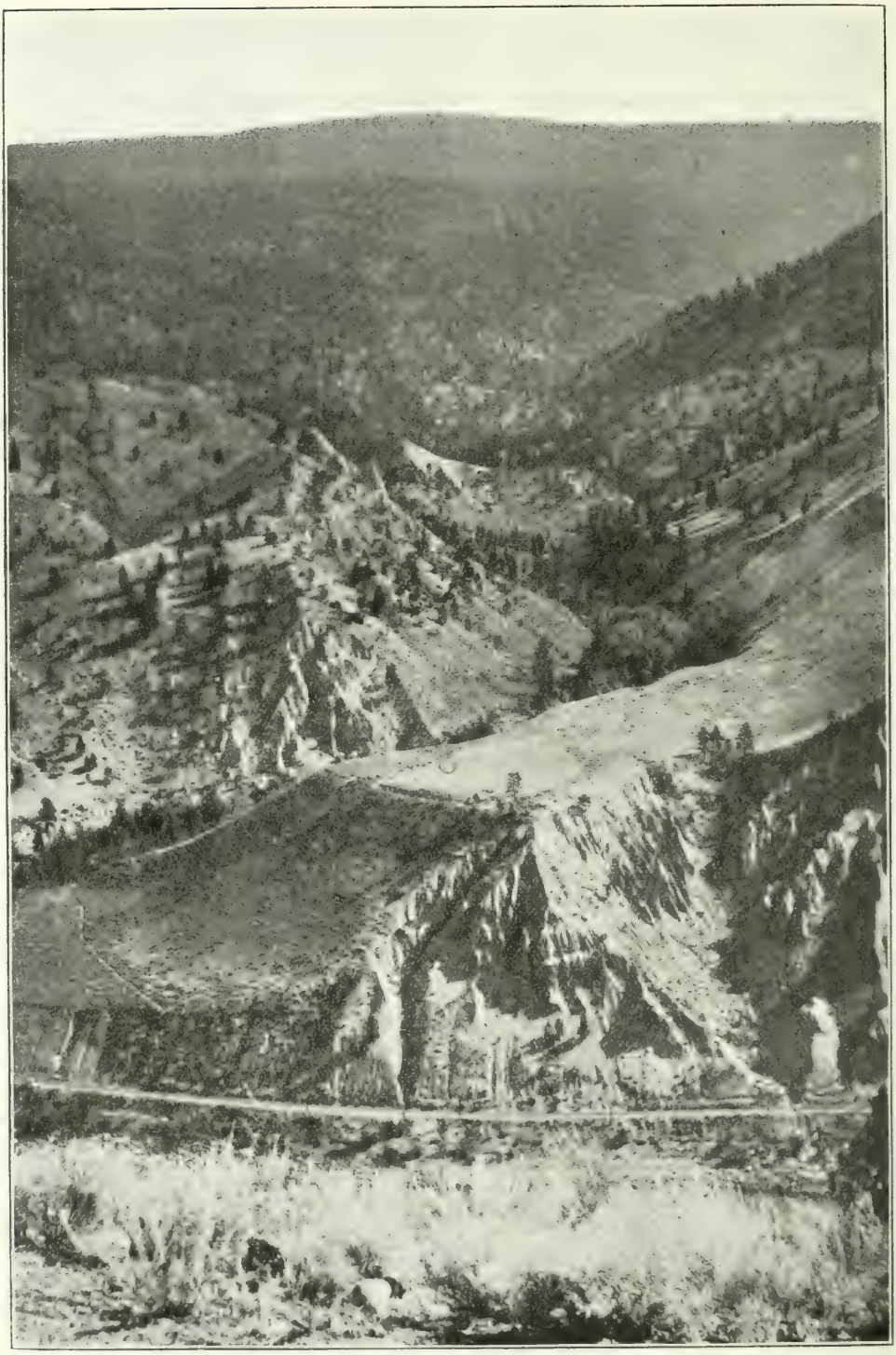
Frog Creek.—A small tributary of Deadman river, in township 22-20-6. (Deadman-Thompson drainage.)

Frog Lake.—An expansion of Frog creek, in township 22-5-6. (Frog-Mabel lake-Shuswap drainage.)

Frog Lake.—A small lake in township 18-18-6.

Garnet Creek.—A small stream flowing into Ruby creek, in township 5-27-6. (Ruby-Fraser drainage.)

Geikie Creek.—A small glacial stream flowing into the Incomappleux, in township 25-26-5. (Incomappleux-Columbia drainage.)



Valley of Five Mile Creek, near Spences Bridge, B. C.

Gilley Creek.—A small tributary of Pitt river from the west, in township 40, E.C.M.; small industrial power. Also called Munro creek. For hydrographic data see River Station on Gilley creek. (Pitt-Fraser drainage.)

Glacier Creek.—A small stream flowing into Slesse creek, a tributary of Chilliwack river, in township 1-28-6. (Slesse-Chilliwack-Fraser drainage.)

Genogle Creek.—A small tributary of Kicking Horse river from the north, in township 27-20-5. Drainage area, 38 square miles. Estimated maximum discharge (June) 300 c.f.s. Estimated minimum discharge during the severe winter, 5 c.f.s. (Kicking Horse-Columbia drainage.)

Gold Creek.—A tributary of Coquitlam river from the east, just below Coquitlam lake. See measurements of discharge on Gold creek. (Coquitlam-Fraser drainage.)

Gold Creek.—A tributary of Columbia river from the west, 17 miles north of Beavermouth, in township 32-26-5. (Columbia drainage.)

Gold Creek.—A small tributary of Columbia river from the west, in township 21-1-6, below Revelstoke.

Goodfellow Creek.—A tributary of Bush river from the south, in township 33-24-5. (Bush-Columbia drainage.)

Goodsir Creek.—A mountain torrent flowing into Ottertail river, in township 26-18-5. (Ottertail-Kicking Horse-Columbia drainage.)

Goose Lake.—A small lake discharging into Sumas river, in township 20, E.C.M. (Sumas-Fraser drainage.)

Gordon Creek.—A small stream flowing into Fraser river from the west, in township 7-26-6. (Fraser drainage.)

Gordon Creek.—Probably the same creek as Dairy creek flowing into the North Thompson river, in township 21-17-6. See miscellaneous measurements on Gordon creek. (North Thompson drainage.)

Gorge Creek.—A tributary of Deadman river, in township 23-22-6. (Deadman-Thompson drainage.)

Graingers Creek.—A small irrigation stream flowing into the upper Columbia river, in section 6, township 27-21-5. (Upper Columbia drainage.)

Granite Creek.—A small stream flowing into Salmon arm in township 21-10-6. (Shuswap lake-South Thompson drainage.)

Graves Creek.—The lower part of Maiden creek, in township 23-26-6, flowing into Bonaparte river. On June 6, 1911, the discharge was 2 c.f.s. (Bonaparte-Thompson drainage.)

Greeley Creek.—A tributary of Illecillewaet river from the south, in township 23-1-6, proposed city of Revelstoke water supply. (Illecillewaet-Columbia drainage.)

Greenstone Creek.—A small irrigation stream rising in Face lake and Big Fish lake and flowing southerly into Meadow creek, in township 17-20-6. For hydrographic data see River Station on Greenstone creek. (Meadow-Guichon-Nicola-Thompson drainage.)

Griffin Lake.—A broadening of Eagle river, in township 23-4-6. (Eagle-Shuswap lake-South Thompson drainage.)

Grizzly Creek.—A mountain torrent flowing into Beaver river from the east, in township 27-25-5. (Beaver-Columbia drainage.)

Guichon Creek.—(Also called Ten-mile creek, Mamette creek, Na-a-a creek, Kazoom Kamoist), an important and contentious irrigation stream, rising in the Railway Belt, about township 19-22-6, and flowing southerly for 35 miles into Nicola river. For hydrographic data see River Station on Guichon creek. (Nicola-Thompson drainage.)

Haggen Lake.—A very small lake in section 35, township 20-13-6. (South Thompson drainage.)

Hamilton Creek.—Local name of small tributary of Illecillewaet river from the north near Revelstoke in township 24-1-6; city of Revelstoke water supply. (Illecillewaet-Columbia drainage.)

Haner Creek.—A small stream near Revelstoke.

Harper Lake.—A very small lake in section 34, township 20-13-6. (South Thompson drainage.)

Harrison Creek.—A small tributary of South Thompson river in township 20-14-6. (South Thompson drainage.)

Harrison Lake.—A large lake about 40 miles long and from 2 to 4 miles wide, emptying into Harrison river from the north. (Harrison-Fraser drainage.)

Harrison River.—A large tributary of Fraser river from the north, 60 miles east of Vancouver, in township 3-30-6. (Fraser drainage.)

Haskin Creek.—A small tributary of Ottertail river, in township 27-18-3. (Ottertail-Kicking Horse-Columbia drainage.)

Hat Creek.—An important and contentious irrigation stream rises in the hills about 15 miles west of Ashcroft and, after flowing 30 miles in a northerly direction, discharges into Bonaparte river, in township 22-25-6. For complete description and hydrographic data see River Station on Hat creek. (Bonaparte-Thompson drainage.)

Hatch Creek.—A very small stream flowing into Upper Columbia river from the east, in township 23-18-5. (Upper Columbia drainage.)

Hatzic Lake.—A tidal lake on the north side of Fraser river in the northeast corner of township 17, E.C.M. (Fraser drainage.)

Hays Creek.—A small stream near Revelstoke.

Hefferly Creek.—Also called Heffly and Hefferley, an important and contentious irrigation stream flowing into the North Thompson river from the east, in township 22-17-6. For hydrographic data see River Station on Hefferly creek. (North Thompson drainage.)

Hefferly Lake.—A small lake near the head of Hefferly creek, in section 1, township 22-16-6; used as a storage reservoir for irrigation purposes. (Hefferly-North Thompson drainage.)

Hicks Lake.—A small lake in township 4-28-6, flowing into Trout lake, thence into Harrison lake. (Trout lake-Harrison lake-Harrison-Fraser drainage.)

Hidden Lake.—A small lake in township 18-6-6, emptying northerly into Shuswap river. (Shuswap-Thompson drainage.)

Hihium Creek.—A tributary of Loon creek and Bonaparte river near the north limit of the Railway Belt. (Loon-Bonaparte-Thompson drainage.)

Hihium Lake.—In township 24-23-6 (elevation 4,500 feet), flowing westerly into Hihium creek.

Hixon Creek.—A small tributary of Mesliloet river from the east, in township 6-7-7. On October 19, 1912, the discharge was 71 c.f.s. Industrial power and logging. (Mesliloet drainage.)

Hogranch Creek.—A small tributary of Upper Columbia river from the east, about 23 miles south of Golden, in township 24-19-5. On July 15, 1912, the discharge was 10·5 c.f.s., and this may be considered about the mean summer flow. (Upper Columbia drainage.)

Holachten Creek.—A small stream in township 24, E.C.M., flowing into Nicomen slough, thence the Fraser river. (Fraser drainage.)

Hornet Creek.—A tributary of Silver creek, in township 7-29-6. (Silver-Harrison-Fraser drainage.)

Horse Creek.—A small tributary of Upper Columbia river from the east, in township 26-21-5. See miscellaneous measurements. (Upper Columbia drainage.)

Horsethief Creek.—A large tributary of Upper Columbia river from the west, 80 miles south of Golden; outside the Railway Belt. For hydrographic data see River Station on Horsethief creek. (Upper Columbia drainage.)

Hospital Creek.—A small tributary of the Columbia river from the east, about 1 mile north of Golden, in township 27-22-5. Used for irrigation. (Columbia drainage.)

Howe Lake.—A small reservoir near the head of Jamieson creek. (Jamieson-North Thompson drainage.)

Huff Lake.—A small lake in township 23-16-6, emptying into Sullivan creek. (Sullivan-North Thompson drainage.)

Hughes Lake.—A small storage reservoir in township 19-19-6, into which the water of Alkali creek is diverted for irrigation purposes. (Alkali-Cherry-Thompson drainage.)

Hull Arden Creek.—A small tributary of Fraser river from the east above Lytton, in township 15-27-6. (Fraser drainage.)

Hummingbird Creek.—A small stream flowing into Mara lake from the east in township 21-8-6. (Shuswap-South Thompson drainage.)

Humphrey Lake.—Local name of small lake in township 17-19-6.

Hunakwa Lake.—A lake 3 miles long discharging southerly into Anstey creek, thence into Anstey arm of Shuswap lake. (Shuswap lake-South Thompson drainage.)

Hunger Creek.—A small stream in section 20, township 10-29-6.

Hunter Creek.—A small tributary of Fraser river from the south, in township 5-27-6. A little water is used for irrigation, and a small industrial power development is possible, with a high head (700 feet in 2 miles). (Fraser drainage.)

Hyak Creek.—A small tributary of Pitt lake, in township 6-4-7. (Pitt-Fraser drainage.)

Ice River.—The largest tributary of Beaverfoot river, in township 25-18-5. Scenic beauty and mining. (Beaverfoot-Kicking Horse-Columbia drainage.)

Illecillewaet River.—An important glacial stream rising in Illecillewaet glacier and flowing westerly into the Columbia at Revelstoke. Power, timber and scenic interests. For complete description and hydrographic data see River Station on Illecillewaet river. (Columbia drainage.)

Incomappleux River.—(Also called Fish creek). A stream about 42 miles long rising in the Selkirks behind Glacier, B.C., from mountains 8,000 feet to 10,000 feet high. It flows in a general southerly direction, discharging into north arm of Arrow Arrow lake near Comappleux, at an elevation of 1,390 feet. Its drainage area is 460 sq. miles, being mostly timbered country, extensive limits being held by the Arrow Lakes Lumber Co. and the Dominion Saw-mills. There is practically no agricultural land in the valley. On September 16, 1912, at the mouth, the discharge was 1,520 c.f.s. The estimated maximum discharge in July is about 5,000 c.f.s. The estimated minimum discharge during the winter is about 100 c.f.s.

The stream is swift, from 50 feet to 150 feet wide, and from 3 feet to 10 feet deep. The river is not navigable, but is suitable for logging purposes.

The power possibilities on this stream are worthy of future investigation. There is a canyon about 2½ miles from the mouth. The canyon is 3,000 feet long, and there

is a fall of 100 feet. Its width is from 60 feet to 100 feet, and the rocky banks are high and steep. There is very little natural storage and for a large development, artificial storage would be required. Water could be penned back over a large flat on which lies the old townsite of Canbourne. This would be an expensive installation.

Small summer industrial power of from 100 to 300 horse-power could be obtained on the following tributaries: Sable creek, Pool creek, Lexington creek and Boyd creek. The flow in each case is small, but high heads could be obtained.

Indian River.—Now called Mesliloet river.

Indian Garden Creek.—A small irrigation stream on the south of Thompson river in township 20-21-6, about 2 miles below Savona. (Thompson drainage.)

Indian Scottie Creek.—A small stream in the hills to the south of Oregon Jack creek.

Ingram Creek.—An irrigation stream flowing into Salmon river from the south, in township 17-13-6, near Grand Prairie. For hydrographic data see River Station on Ingram creek. (Salmon-Shuswap lake-South Thompson drainage.)

Inkathsaph Creek.—A small tributary of Fraser river from the east, in township 12-26-6. (Fraser drainage.)

Inkikuh Creek.—A small tributary of Thompson river from the east near Spences Bridge, in township 18-24-6. Locally called Seven-mile creek. (Thompson drainage.)

Inkoika Creek.—A small tributary of Fraser river from the west, above Lytton, in township 16-27-6. (Fraser drainage.)

Intlpam Creek.—A small tributary of Fraser river from the west above Lytton, in township 17-27-6. (Fraser drainage.)

Island Pond.—Flows into Hefferly creek in township 22-16-6. (Hefferly-North Thompson drainage.)

Isaac Creek.—Now called Akolkolex river.

Izman Creek.—A small tributary of Fraser river from the east above Lytton, in township 16-27-6. (Fraser drainage.)

Jack Creek.—Also called Chartrand creek.

Jack Creek.—Also called Oregon Jack creek.

Jacko Creek.—A tributary of Peterson creek in township 19-18-6. The water is used for irrigation. For hydrographic data see River Station on Jacko creek. (Peterson-South Thompson drainage.)

Jones Creek.—(Called formerly Wahleach creek.) Flows from Jones lake, in township 3-27-6, into Fraser river. (Fraser drainage.)

Jones Creek and Lake.—Probably small tributary of Peterson creek, in township 19-17-6 or 19-18-6. Irrigation. (Peterson creek-Thompson drainage.)

Jones Lake.—A small lake situated in a valley high up in a spur of Cheam mountains, about 7 miles from Agassiz, in township 3-27-6, at an elevation of about 1,950 feet (barometer). The drainage area is 40 square miles. It discharges northerly into Jones creek (formerly called Wahleach creek), thence into Fraser river.

Hydrographic investigations of the flow from Jones lake have been carried on for two years for the Vancouver Power Company by Messrs. Anderson and Warden, civil engineers, of Vancouver, with a view to developing water-power. It is proposed to divert Jones lake by means of a tunnel through the mountains due west of the lake, installing the power house in the Fraser valley. In this way a head of some 1,800 feet would be obtained. The tunnel would be about 2 miles long.

Jones lake would be used as a reservoir. Its area is about 1,260 acres, and a 50-foot dam would be constructed.

The precipitation around Jones lake is about 70 to 80 inches per annum. (Fraser drainage.)

Jacko Lake.—Receives the waters of Jacko creek, then drains into Peterson creek, in township 19-18-6. Used as a storage reservoir. (Peterson-South Thompson drainage.)

James Creek.—A small irrigation stream in township 21-22-6, flowing from Twin lakes (now used as a storage reservoir) into Thompson river, near Walhachin. The waters of this creek are used by the British Columbia Horticultural Estate for irrigation purposes, but as the supply is very small, the waters of Barnes creek are diverted across the divide into Lake of the Woods reservoir (in section 14, township 20-23-6) thence into Twin Lakes reservoir, thence down the bed of James creek.

Jamieson Creek.—An important irrigation stream flowing into North Thompson river from the west, in township 22-17-6. This creek supplies the water for the large British Columbia Fruitlands irrigation canal. For hydrographic data see River Station on Jamieson creek. (North Thompson drainage.)

Jamieson Creek.—A small tributary of Fraser river from the east, in township 12-26-6. (Fraser drainage.)

Jim Black's Lake.—A small lake in Highland valley, in township 18-24-6.

Jimmies Creek.—A small stream on the south side of Thompson river, in township 20-22-6. (Thompson drainage.)

Johnstons Creek.—A small tributary of Shuswap river in township 20-8-6. (Shuswap-South Thompson drainage.)

Johnston Draw Creek.—Probably flows into Nelson creek, thence into Columbia river, 18 miles south of Golden. (Nelson-Upper Columbia drainage.)

Jordan River.—About 20 miles long. It has its source about township 25-3-6 in the snow-capped peaks of the Gold range and, flowing in a southeasterly direction, empties into the Columbia river near Revelstoke. Its drainage area is 100 square miles. The drainage area is mostly timbered, and the valley near its source is open rolling country, but near the mouth is heavily timbered. There is some agricultural land at the head of the river, but it is at a rather high elevation.

An estimated maximum discharge in July is 2,000 c.f.s.; the estimated minimum discharge is 50 c.f.s. during the severe winter. The stream is swift, 30 feet to 100 feet wide and 3 feet to 10 feet deep, and is not navigable.

The average precipitation is about 40 inches per annum (30 inches rain and 120 inches snow.)

The power possibilities of this stream are worthy of future investigation. Two miles from the mouth there is a canyon 1,500 feet long in which the fall is 80 feet. Below the canyon is the Jordan falls, with a drop of 20 feet. In an S-shaped canyon below the falls there is a fall of 55 feet. (Columbia drainage.)

July Creek.—A small tributary of the head-waters of Coldwater river, in township 9-23-6. (Coldwater-Nicola-Thompson drainage.)

Jules Lake.—A small lake in township 24-21-6. (Deadman-Thompson drainage.)

Kamloops Lake.—A broadening of the Thompson river; some 20 miles long and from 2 to 3 miles wide.

Kanaka Creek.—A small stream flowing into the Fraser river near Haney, in township 12 E.C.M. (Fraser drainage.)

Kawkawa Lake.—Draining into Coquihalla river near Hope in township 5-22-6. (Coquihalla-Fraser drainage.)

Kazoom Kanaix.—Now called Guichon creek. (Q.V.)

Keikum Creek.—A tributary of the Fraser river from the east, in township 6-22-6. (Fraser drainage.)

Kellie Creek.—A tributary of Incomappleux river from the east, in township 22-26-5. (Incomappleux-Columbia drainage.)

Kenuff Lake.—Also called Knouff lake, draining into Sullivan creek, in township 23-16-6. Recorded for irrigation purposes. (Sullivan-North Thompson drainage.)

Kicking Horse River.—An important river, rising in Kicking Horse pass in the summit of the Rocky mountains, and flowing in a westerly direction into Columbia river at Golden. Timber, mining, power and scenic interests. For complete description and hydrographic data see River Station on Kicking Horse river. (Columbia drainage.)

Kingfisher Creek.—A small tributary of Shuswap river from the north, near Mabel lake, in township 19-6-6. (Shuswap-South Thompson drainage.)

Kiwetinok River.—A tributary of Amiskwi river, in township 28-19-5. (Amiskwi-Kicking Horse-Columbia drainage.)

Klesilkwa Creek.—A tributary of Skagit river; thence into United States; township 2-25-6.

Klowa Creek.—A tributary of the Fraser river from the west, in township 14-27-6, just below Lytton. (Fraser drainage.)

Kootenay River.—One of the most important rivers in British Columbia; has its source near the south limit of the Railway Belt, in township 24-17-5.

Kwellanka Creek.—A small tributary of Fraser river from the west, in township 14-27-6, just below Lytton. (Fraser drainage.)

Kwoiek Creek.—A tributary of Fraser river from the west, in township 13-27-6. (Fraser drainage.)

Lambkin Creek.—A small tributary of Columbia river from the east, 2 miles below (north of) Golden, in township 27-22-5. (Columbia drainage.)

Ladner Creek.—A tributary of Coquihalla river, in township 6-24-6. (Coquihalla-Fraser drainage.)

La Forme Creek.—A small tributary of Columbia river from the east, in township 26-2-6, above Revelstoke. Timber and mining interests. (Columbia drainage.)

Laluwissin Creek.—A small tributary of Fraser river from the east, above Lytton, in township 17-27-6, (Fraser drainage.)

Lanes Creek.—A small irrigation stream flowing into North Thompson river at the north boundary of township 21-17-6. See miscellaneous measurements on Lanes creek. (North Thompson drainage.)

Last Chance Creek.—Flows into Deadman lake (outside Railway Belt). Deadman-Thompson drainage.)

Last Chance Creek.—Now called Stein creek.

Leighton Lake. A small storage lake, in township 19-21-6, beside Tunkwa lake, into which the waters of Upper Guichon creek are diverted, stored and conducted down Three-mile creek for irrigation purposes. Sometimes called Little lake. (Three-mile-Thompson drainage.)

Lemonade Creek.—A small tributary of Columbia river from the east, in township 26-21-5, 4 miles south of Golden. The water is used for domestic and irrigation purposes. (Upper Columbia drainage.)

Leighton Lakes, B. C.

Lewis Creek.—A small tributary of Sumas lake, in township 23, E.C.M. (Sumas-Fraser drainage.)

Lexington Creek.—A small tributary of Incomappleux river from the east, in township 22-7-5. Timber and possibly small power. (Incomappleux-Columbia drainage.)

Lihumitson River.—A tributary of Chilliwack river from the south, in township 25, E.C.M. (Chilliwack-Sumas-Fraser drainage.)

Lillooet Lake.—A lake some 8 miles long at the head of Lillooet river. (Lillooet-Pitt-Fraser drainage.)

Lillooet River.—Rises in Lillooet lake, in township 4-4-7, and flows into Pitt river in township 40, E.C.M. This river is tidal for 5 or 6 miles from its mouth. Important timber and power interests. For complete description and hydrographic data see River Station on Lillooet river. (Pitt-Fraser drainage.)

Limestone Creek.—A small tributary of Hat creek from the west in township 20-27-6. (Hat-Bonaparte-Thompson drainage.)

Little Lake.—Now called Leighton lake.

Little Shuswap Lake.—A broadening of the Thompson river just below Shuswap lake, and near Chase, B.C. (South Thompson drainage.)

Lloyd Creek.—A small tributary of Paul creek, in township 20-16-6. See miscellaneous measurements. (Paul-North Thompson drainage.)

Loakin Creek.—Flows into Niskonlith lake, in township 21-13-6. (South Thompson drainage.)

Log Creek.—A tributary of Nahatlatch river from the north, in township 12-27-6. (Nahatlatch-Fraser drainage.)

Long Lake.—A small lake in township 18-17-6. (Campbell-South Thompson drainage.)

Loon Creek.—A tributary of Bonaparte river from the east, just outside the Railway Belt. (Bonaparte-Thompson drainage.)

Loon Lake.—At the head of Loon creek; it is proposed to use this lake as a storage reservoir for irrigation purposes along the Bonaparte river. (Loon-Bonaparte-Thompson drainage.)

Loon Lake.—A tiny lake in section 7, township 22-10-6. (Shuswap-Thompson drainage.)

Loon Lake.—Draining into the north Fork of Spillimacheen river, in township 24-21-5. (Spillimacheen-Upper Columbia drainage.)

Loop Creek.—A small tributary of Illecillewaet river from the south, passing under the Loop near Glacier, in township 26-26-5. (Illecillewaet-Columbia drainage.)

Lopez Creek.—A tributary of Cache creek, in township 21-24-6; a very small irrigation stream. (Cache-Bonaparte-Thompson drainage.)

Louis Creek.—Rises in township 22-15-6 and flows north and west into North Thompson river, about 40 miles north of Kamloops. Mining, irrigation and small power. (North Thompson drainage.)

Louis Lake.—A small lake emptying into Paul lake, in township 21-16-6. (Paul-North Thompson drainage.)

Luckachin Creek.—A tributary of Nicola river from the east, in township 16-24-6. (Nicola-Thompson drainage.)

Luckakuck River.—The original channel of Chilliwack river, in township 23, E.C.M., from which the latter was diverted down the Vedder river channel. (Sumas-Fraser drainage.)

Lytton Creek.—A small tributary of the Fraser from the east of the town of Lytton: C.P.R. and town of Lytton water supply. (Fraser drainage.)

Macaulay Creek.—Probably a tributary of Lanes creek, in township 22-17-6. (Lanes-North Thompson drainage.)

McArthur Creek.—A tributary of the Ottertail river from the east, in township 27-17-5. (Ottertail-Kicking Horse-Columbia drainage.)

McArthur Lake.—A beautiful lake in the heart of the Rocky mountains, in township 27-17-5.

McCallum Creek.—A small irrigation stream on the south side of Thompson river in township 20-21-6. Also called Upper Ranch creek. (Thompson drainage.)

McDougal Creek.—A tributary of Incomappleux river from the west, in township 23-26-5. Timber interests. (Incomappleux-Columbia drainage.)

McGillivray Creek.—A tributary of Louis creek from the east, in township 22-15-6. Irrigation and small power. On August 21, 1912, the discharge was 5·5 c.f.s. (Louis-North Thompson drainage.)

McGillivray Creek.—A small tributary of Sumas river, in township 20 E.C.M. (Sumas-Fraser drainage.)

McLean Lake.—A small lake at the head-waters of Cornwall creek, in township 21-25-6 (Cornwall-Thompson drainage.)

McLean Creek.—Small tributary of Canyon creek, in township 26-22-5. Timber. (Canyon-Upper Columbia drainage.)

McMurdo Creek.—A tributary of North Fork of Spillimacheen river from the south, in township 25-23-5. Mining interests. (Spillimacheen-Upper Columbia drainage.)

McQueen Creek.—A small irrigation stream flowing into North Thompson river from the west, near Dairy creek, in township 21-17-6. (North Thompson drainage.)

McRae Creek.—A tributary of Incomappleux river from the west, in township 22-27-5. Timber and small power. (Incomappleux-Columbia drainage.)

Mabel Lake.—A lake 18 miles long, and from 1 to 2 miles wide, draining into Shuswap river, in township 19-6-6. Good storage for proposed power development on Shuswap river. (Shuswap-South Thompson drainage.)

Maiden Creek.—A small tributary of Allen creek in township 23-26-6. Irrigation. The water of Maiden creek sinks in one place and, where it rises, it is called Graves creek. (Allen-Bonaparte-Thompson drainage.)

Maleys Creek.—A small stream in township 24-2-6, near Revelstoke.

Mamit Creek.—Now called Guichon creek (Q.V.)

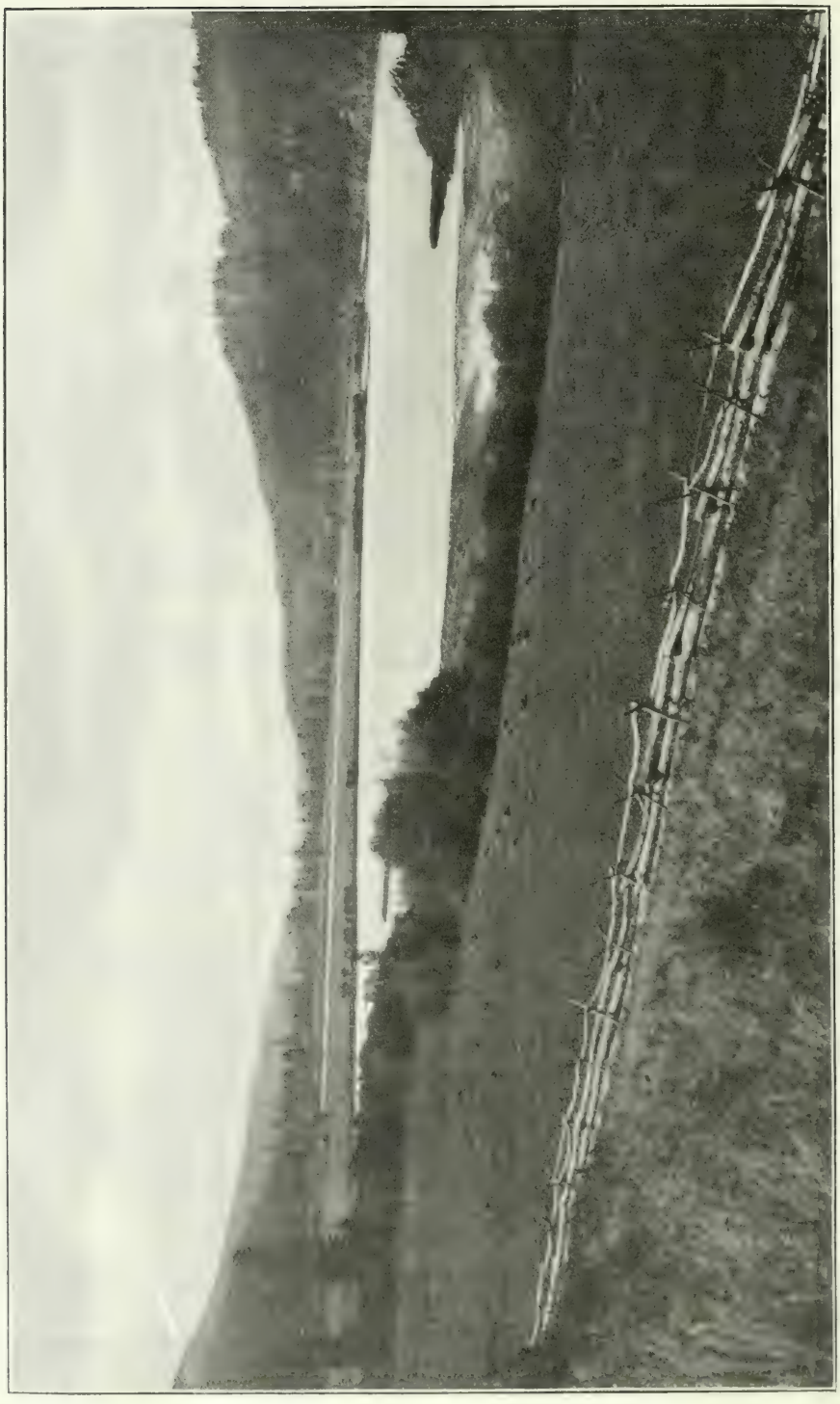
Mamit Lake.—(Or Mamette lake).—An expansion of Guichon creek, just outside the Railway Belt. A possible storage reservoir for Guichon creek waters at Lower Nicola. (Guichon-Nicola drainage.)

Manitoba Creek.—A very small stream in township 25-20-5, south of Golden. (Upper Columbia drainage.)

Mann Creek.—A small stream in township 17-10-6.

Manson Creek.—A small creek flowing into Shuswap lake from the north, in township 23-10-6. (Shuswap lake-South Thompson drainage.)

Mara Lake.—A broadening of Shuswap river just as it enters Shuswap lake at Sicamous. (Shuswap-South Thompson drainage.)



Upper end of Mamit Lake at low water.

Maria Slough.—A side channel of Fraser river in township 4-28-6. (Fraser drainage.)

Marion Lake.—A small scenic mountain lake in township 26-26-5. (Illecillewaet-Columbia drainage.)

Marl Creek.—A tributary of Columbia river from the north, near Donald, in township 29-23-5. (Columbia drainage.)

Martin Creek.—A small irrigation stream flowing into the South Thompson river from the south, in township 20-14-6. See miscellaneous measurements. (South Thompson drainage.)

Meadow Creek.—The largest tributary of Guichon creek, rising in Long Lake Forest Reserve and flowing westerly. Used for irrigation. For hydrographic data see River Station on Meadow creek. (Guichon-Nicola-Thompson drainage.)

Meadow Creek.—A small tributary of Shuswap lake from the north, in township 23-10-6. (Shuswap lake-South Thompson drainage.)

Medicine Creek.—A small tributary of Hat creek from the east, generally dry, in township 21-26-6. (Hat-Bonaparte-Thompson drainage.)

Menanteau Lake.—A tiny lake in section 12, township 18-18-6.

Menhenick Creek.—A small tributary of Incomappleux river from the west, in township 21-27-5. (Incomappleux-Columbia drainage.)

Mesliloet River.—(Also called Indian river). A stream flowing into the North Arm of Burrard inlet from the north, and forming the westerly boundary of the Railway Belt; small power developments possible. For complete description and hydrographic data see River Station on Mesliloet river.

Middle Creek.—A small tributary of Nesakwatch river in township 1-26-2. (Nesakwatch-Chilliwack-Fraser drainage.)

Mill Creek.—A tributary of the northeast arm of Upper Arrow lake in township 21-28-5. (Columbia drainage.)

Mill Creek.—A small stream flowing into Eagle river, near Three Valley, in township 23-4-6. (Eagle-Shuswap lake-Thompson drainage.)

Mill Creek.—A small tributary of Tonka Watla river, in township 23-2-6. (Tonka-Watla-Columbia drainage.)

Miller Lake.—A small lake in township 19-13-6.

Minnaberriet Creek.—A small irrigation stream flowing into Thompson river from the west, in township 20-24-6. Generally dry. (Thompson drainage.)

Misko Creek.—A tributary of Ottertail river, in township 26-17-5. (Ottertail-Kicking Horse-Columbia drainage.)

Mitre Creek.—A very small tributary of Incomappleux river, at its head-waters, in township 25-26-5. (Incomappleux-Columbia drainage.)

Monte Creek.—An important and contentious irrigation stream rising in Monte Hills Forest Reserve and, flowing northerly, discharging into South Thompson river at Ducks. For complete description and hydrographic data see River Station on Monte creek. (South Thompson drainage.)

Monte Lake.—Now called Summit lake.

Moore Creek.—Rises in the Railway Belt, in township 16-18-6, and flows southerly into Nicola lake. (Nicola-Thompson drainage.)

Moose Creek.—A small tributary of Beaverfoot river, near its head, in township 24-17-5. (Beaverfoot-Kicking Horse-Columbia drainage.)

Morneilun Creek.—A small tributary of Fraser from the east, in township 13-27-6. (Fraser drainage.)

Morris Lake.—A small lake in Morris river, in township 4-29-16.

Morris River.—Flows into Harrison river in township 4-29-6. Government fish hatchery. (Harrison-Fraser drainage.)

Mosky Lake.—A tiny lake in section 4, township 22-10-6.

Moulton Creek.—A small irrigation stream flowing into South Thompson river, in township 20-14-6. See hydrographic data on Moulton creek.

Mountain Creek.—A mountain torrent flowing into Beaver river from the west, in township 29-25-5. (Beaver-Columbia drainage.)

Mountain Creek.—East fork of Canoe creek, in township 20-9-6. City of Salmon Arm water supply. (Canoe-Shuswap lake-Thompson drainage.)

Mowhokam Creek.—A small tributary of Fraser river from the east, in township 12-26-6. (Fraser drainage.)

Mowich Lake.—Near Deadman river, in township 24-21-6.

Mummery Creek.—A glacial stream 2 miles long, flowing into Blaeberry river, in township 31-20-5. (Blaeberry-Columbia drainage.)

Munro Creek.—Also called Gilley creek. (Q.V.)

Murray Creek.—A tributary of Thompson river from the northwest, in township 17-25-6. Irrigation, power and domestic supply. See River Station on Murray creek. (Thompson drainage.)

Murray Lake.—Drains into Coldwater river, in township 10-23-6. (Coldwater-Nicola-Thompson drainage.)

Na-a-a River.—Now called Guichon creek.

Nahatlatch Lakes.—A chain of four narrow lakes, in townships 12-27-6 and 12-28-6; suitable for storage reservoirs for power purposes. (Nahatlatch-Fraser drainage.)

Nahatlatch River.—Sometimes called Salmon river, an important tributary of Fraser river from the west, in township 12-26-6. Timber and power. For complete description and hydrographic data see River Station on Nahatlatch river. (Fraser drainage.)

Napier Lake.—A narrow lake 1 mile long at the head-waters of Campbell creek, in township 17-17-6. (Campbell-South Thompson drainage.)

Narao Lake.—A small mountain lake south of Hector, in township 28-17-5 (Kicking Horse-Columbia drainage.)

Navy Creek.—A tributary of the south fork of Bush river, in township 32-23-5. (Bush-Columbia drainage.)

Ned's Creek.—A small irrigation stream flowing into South Thompson river from the south, in township 19-14-6. See miscellaneous measurements. (South Thompson drainage.)

Nekertch Creek.—A small tributary of Fraser river from the west, above Lytton, in township 16-27-6. (Fraser drainage.)

Nekliptum Creek.—A small tributary of Fraser river from the east, in township 13-27-6. (Fraser drainage.)

Nelson Creek.—A small irrigation stream flowing into Thompson river, in township 20-24-6. See hydrographic data of River Station on Nelson creek. (Thompson drainage.)

Nelson Creek.—A small irrigation stream flowing into the Columbia river from the east, in section 9, township 25-20-5. On July 15, 1912, the discharge was 2 c.f.s. (Upper Columbia drainage.)

Nelson Lake.—A small lake in township 20-24-6, draining into Nelson creek. (Nelson-Thompson drainage.)

Nepopulchin Creek.—A small tributary of Fraser river from the west, in township 11-26-6. (Fraser drainage.)

Nepuchin Creek.—A small tributary of Fraser river, in township 16-27-6. (Fraser drainage.)

Nesakwatch Creek.—A tributary of Chilliwack river from the south in township 1-27-6. (Chilliwack-Fraser drainage.)

Nescantell Creek.—Now called Niskonlith creek.

Newman Lake.—Now called Trapp lake.

Nicola River.—An important tributary of Thompson river rising in Nicola lake, and, flowing for 50 miles in a northerly direction, discharging into Thompson river at Spences Bridge. For complete description and hydrographic data see River Station on Nicola river. (Thompson drainage.)

Nicolson Creek.—A very small tributary of Upper Columbia river from the east, in township 26-21-5, between 4 and 5 miles from Golden. (Upper Columbia drainage.)

Nicolum River.—A tributary of Coquihalla river, in township 5-25-6. (Coquihalla-Fraser drainage.)

Nicomekl River.—A small river flowing into Boundary bay, in township 1, W. C.M.

Nicomen River.—A small tributary of Thompson river from the east, in township 15-25-6. (Thompson drainage.)

Niger Creek.—A small tributary of Fraser river from the east, in township 13-27-6. (Fraser drainage.)

Nikaia Creek.—A small tributary of Fraser from the west, in township 14-27-6, below Lytton. See miscellaneous measurements. (Fraser drainage.)

Nikwa Creek.—A small tributary of Fraser river from the west, in township 16-27-6, above Lytton. (Fraser drainage.)

Nikwikwaia Creek.—Flows into Adams river from the east, just below the outlet of the lake. (Adams-Shuswap lake-South Thompson drainage.)

Ninemile Creek.—A small tributary of Fraser river from the east, in township 11-26-6. (Fraser drainage.)

Ninemile Creek.—A small tributary of Upper Columbia river from the east, in township 26-21-5. (Upper Columbia drainage.)

Niskonlith Creek.—A small stream flowing into South Thompson river from the north, in township 21-13-6. Used for irrigation. (South Thompson drainage.)

Niskonlith Lake.—A lake 3 miles long, in township 21-13-6, emptying into Niskonlith creek.

Noble Creek.—Also called Lane creek.

Nohomin Creek.—A tributary of Fraser river from the west, in township 15-27-6, just above Lytton. A contentious irrigation stream. (Fraser drainage.)

Noisy Creek.—A small stream flowing into Mabel lake from the north, in township 20-5-6. (Mabel lake-Shuswap-South Thompson drainage.)

North Lillooet River.—A branch of Lillooet river flowing mostly through Pitt river Meadows. See hydrographic data on North Lillooet river. (Lillooet-Pitt-Fraser drainage.)

Norton Creek.—A tributary of Brandt creek, thence of Mesliloet river from the east in township 6-7-7. Timber and small power. On October 20, 1912, the discharge was 7·7 c.f.s. (Mesliloet drainage.)

Norton Lake.—A small storage lake at the head of Norton creek.

No. 2 Creek.—A tributary of Upper Columbia river from the west, 9 miles below lake Windermere. The water is used for irrigation. Outside the Railway Belt. For hydrographic data see River Station on No. 2 creek. (Upper Columbia drainage.)

Novelist Creek.—A small tributary of Gold creek, in township 31-27-5. (Gold-Columbia drainage.)

Nuaitch Creek.—A small tributary of Nicola river, in township 14-23-6. (Nicola-Thompson drainage.)

Oesa Lake.—A scenic mountain lake emptying into Cataract creek, in township 27-17-5. (Cataract-Kicking Horse-Columbia drainage.)

O'Hara Lake.—A scenic mountain lake emptying into Cataract creek, in township 27-17-5. (Cataract-Kicking Horse-Columbia drainage.)

Oregon Jack Creek.—A contentious irrigation stream rising in the Hat Creek Forest Reserve and flowing easterly into the Thompson, in township 19-24-6. For hydrographic data see River Station on Oregon Jack creek. (Thompson drainage.)

Osprey Creek.—A small stream flowing into Pitt lake, in township 6-4-7. (Pitt-Fraser drainage.)

Otter Lake.—A small lake in section 2, township 14, E.C.M. (Fraser drainage.)

Otter Lake.—A small lake at the south limit of the Railway Belt in Okanagan valley. (Okanagan lake-Okanagan-Columbia drainage.)

Otter River.—(Also called Deep creek.)—A small stream flowing southerly into Otter lake in Okanagan valley.

Otterhead River.—A mountain stream, about 12 miles long, flowing in a southerly direction into Kicking Horse river, in township 27-19-5. It has a drainage area of 30 square miles. The water is used for lumbering. At the mouth, the stream is about 25 feet wide and from 2 feet to 3 feet deep. Estimated maximum discharge in June is 250 c.f.s. Estimated minimum discharge in winter is 5 c.f.s. (Kicking Horse-Columbia drainage.)

Otto Creek.—A tributary of Amiskwi river in township 29-19-5. (Amiskwi-township 27-19-5. For complete description, etc., see River Station on Ottertail river. (Kicking Horse-Columbia drainage.)

Otto Creek.—A tributary of Amiskwi river in township 29-19-5. (Amiskwi-Kicking Horse-Columbia drainage.)

Owens Creek.—A small stream near Salmon Arm, in township 20-10-6.

Owl's Head Creek.—A small stream flowing into Eagle river, in township 22-7-6. (Eagle-Shuswap lake-South Thompson drainage.)

Palmers Creek.—A small tributary of Salmon river, in township 20-10-6, near Salmon Arm. See miscellaneous measurements on Palmers creek. (Salmon-Shuswap lake-South Thompson drainage.)

Palmers Meadows.—In township 17-17-6, near the head-waters of Campbell creek.

Pants Creek.—A small tributary of Jamieson creek, in township 22-17-6. (Jamieson-North Thompson drainage.)

Papsilqua Creek.—A small stream flowing into Nicola river, in township 16-23-6. (Nicola-Thompson drainage.)

Parks Creek.—A small stream flowing into Hat creek, in township 22-26-6; used for irrigation. (Hat-Bonaparte-Thompson drainage.)

Pass Creek.—A small tributary of Adams lake from the west, in township 24-13-6. (Adams-Shuswap-South Thompson drainage.)

Pass Lake.—A small lake emptying into Watching creek, in township 22-18-6. (Watching-Tranquille-Thompson drainage.)

Pasulko Lake.—A small lake in township 17-26-6.

Paul Creek.—Also called Reserve creek, Reservation creek and Schedam creek, an important irrigation stream rising in Niskonlith Forest Reserve and flowing in a westerly direction through Kamloops Indian Reserve into North Thompson river, about 2 miles from Kamloops. Irrigation, and possibly small summer power. For hydrographic data see River Station on Paul creek. (North Thompson drainage.)

Paul Lake.—A good storage reservoir on Paul creek, in township 20-16-6.

Paxton Creek.—A small stream flowing into Monte creek from the east, in township 18-14-6. Used for irrigation. (Monte-South Thompson drainage.)

Pearse Creek.—The stream shown on Dominion maps as Pearse creek is really upper Monte creek, in township 16-14-6. Stream locally called Pearse creek flows into Monte creek from the west, in township 18-14-6. (Monte-South Thompson drainage.)

Pemberton Creek.—A small irrigation stream flowing into South Thompson river from the north, in township 20-14-6. For hydrographic data see River Station on Pemberton creek. (South Thompson drainage.)

Pendleton Creek.—A small tributary of Cherry creek, in section 4, township 20-19-6. For hydrographic data see River Station on Pendleton creek. (Cherry-Thompson drainage.)

Penhantan Lake.—Now called Pinantan lake.

Pennies Creek.—Or Penny creek, now called Barnes creek. (Q. V.)

Pennies Lakes.—Now called Twin lakes, in section 25, township 20-23-6. (Q. V.)

Peterson Creek.—A small irrigation stream in township 19-17-6, flowing through the city of Kamloops into South Thompson river. See miscellaneous measurements of the spring flood of Peterson creek in the city of Kamloops. (South Thompson drainage.)

Petit Creek.—Now called Spius creek. (Q. V.)

Pierre River.—A tributary of Coquihalla river, in township 5-25-6. (Coquihalla-Fraser drainage.)

Piglog Creek.—A small tributary of Fraser river from the east, in township 13-27-6. (Fraser drainage.)

Pillar Lake.—At the head-waters of Chase creek, in township 19-12-6. (Chase-South Thompson drainage.)

Pimainus Creek.—Also called Five-mile creek, a tributary of Thompson river from the east, in township 17-24-6, near Spences Bridge. (Thompson drainage.)

Pimainus Lakes.—A chain of small lakes at the head-waters of Pimainus creek, in township 17-23-6. Possible storage for irrigation purposes.

Pinantan Lake.—An enlargement of Paul creek, in section 28, township 20-15-6; good fishing. (Paul-North Thompson drainage.)

Pinaus Lake.—A lake, 2 miles long, in township 17-12-6, draining into Equesis creek, thence into Okanagan lake.

Pipseul Creek.—Now called Meadow creek, a tributary of Guichon creek.

Pit Lake.—Small lake, probably in township 19-17-6 or 19-18-6. (Thompson drainage.)

Pitt Lake.—A tidal lake, about 15 miles long, and from 2 to 4 miles wide, flowing into Pitt river.

Pitt River.—An important navigable stream (tidal) flowing into Fraser river from the north, about 6 miles from New Westminster. (Fraser drainage.)

Pocock Creek.—A small tributary of upper Hat creek from the west, in township 19-26-6. Irrigation. (Hat-Bonaparte-Thompson drainage.)

Pollard Creek.—A small stream flowing into Pitt river from the west, in township 40 E.C.M. For hydrographic data see River Station on Pollard creek. (Pitt-Fraser drainage.)

Porcupine Creek.—A mountain stream, 8 miles long, flowing into Kicking Horse river from the west, near the north boundary of township 26-19-5. No developments or cultivation of any kind along the creek. There is a little timber in the valley. Drainage area is 30 square miles. Estimated maximum discharge in June, 250 c. f. s. Estimated minimum discharge in winter, 5 c. f. s. (Kicking Horse-Columbia drainage.)

Prattle Creek.—A tributary of Bush river from the north, in township 32-25-5. (Bush-Columbia drainage.)

Prospect Creek.—A small tributary of Spius creek in township 12-23-6. (Spius-Nicola-Thompson drainage.)

Pualark Creek.—A very small tributary of Fraser river from the east, in township 6-26-6. (Fraser drainage.)

Pukaist Creek.—Also called Eight-mile creek, a tributary of Thompson river from the east, in township 18-24-6. (Thompson drainage.)

Quartz Creek.—A small tributary of Columbia river from the south, in township 29-25-5, at Beavermouth. Drainage area, 45 square miles. There are several water records on Quartz creek, one by the Columbia River Lumber Company for milling purposes, one by the Canadian Pacific Railway for railway purposes, and one for mining purposes for some placer claims near the mouth of Quartz creek. There are no agricultural or timber interests in the valley of Quartz creek. Estimated maximum discharge in July is 500 c. f. s. Estimated minimum discharge in winter is 8 c. f. s. (Columbia drainage.)

Queest Creek.—Flows into Anstey arm of Shuswap lake from the east, in township 24-7-6. (Shuswap lake-South Thompson drainage.)

Quenville Creek.—A small irrigation stream flowing into Guichon creek from the east, about 1 mile above Mamit lake. It has a drainage area of 7 square miles. It is a flashy stream which runs dry early in July. See miscellaneous measurements of discharge on Quenville creek. (Guichon-Nicola-Thompson drainage.)

Rae Creek or Ray Creek.—A small irrigation stream from the east, just below Mamit lake, flowing into Guichon creek; outside the Railway Belt. (Guichon-Nicola-Thompson drainage.)

Rainbow Creek.—A stream flowing into Pitt lake from the east, in township 6-4-7. See hydrographic data. (Pitt-Fraser drainage.)

Raven Creek.—Now called Rushton creek. (Q.V.)

Red Lake.—At the head-waters of Criss creek, in township 22-21-6. (Criss-Deadman-Thompson drainage.)

Renicker Creek.—A small tributary of Salmon arm of Shuswap lake, in township 21-9-6. (Shuswap lake-South Thompson drainage.)

Reserve Creek or Reservation Creek.—Now called Paul creek. (Q. V.)

Richardson Creek.—A tributary of Spius creek, in township 13-23-6. (Spius-Nicola-Thompson drainage.)

Richardson Lake.—At the head of Deer creek, a tributary of Jamieson creek, in township 22-17-6. (Deer-Jamieson-North Thompson drainage.)

Ridge Lake.—A small lake at the head of Meadow creek, in township 17-19-6. (Meadow-Guichon-Nicola drainage.)

Robbins Creek.—A tributary of Monte creek from the west, in township 19-15-6. The water is used for irrigation. See River Station on Robbins creek. (Monte-South Thompson drainage.)

Roche Lake.—A lake 2 miles long, in township 17-16-6.

Rodero Lake.—Near Barnes creek, near Ashcroft.

Roper Lake.—A small storage reservoir on Cherry creek, in township 19-19-6. (Cherry-Thompson drainage.)

Ross Creek.—A small tributary of Shuswap lake from the north, in township 23-9-6. (Shuswap lake-South Thompson drainage.)

Ross Lake.—A small lake in township 17-18-6.

Ross Lake.—A small lake in the great divide, in township 28-17-5, emptying into Kicking Horse river. (Kicking Horse-Columbia drainage.)

Rough Creek.—A tributary of Fraser river from the east, in township 18-28-6. (Fraser drainage.)

Round Lake.—A small lake in the Okanagan divide, in township 17-10-6.

Ruby Creek.—A small tributary of Fraser river from the north, in township 5-27-6. (Fraser drainage.)

Rushton Creek.—A tributary of Pitt lake from the east, in township 5-4-7. Proposed water-power development for industrial purposes. (Rock crushing and mining.) It is possible to obtain a head of 650 feet. On November 3, 1912, the discharge was 63 c.f.s. Small storage can be obtained on a lake less than 2 miles from the mouth. (Pitt-Fraser drainage.)

Rushton Lake.—A small lake on Rushton creek, in section 18, township 5-4-7.

Sable Creek.—A small tributary of Incomappleux river from the west, in township 22-27-5. Small power and timber interests. (Incomappleux-Columbia drainage.)

Sackum Creek.—A small tributary of Thompson river from the east, in township 15-25-6. (Thompson drainage.)

Salmon Arm.—The most southerly arm of Shuswap lake.

Salmon Creek.—A tributary of northeast arm of Upper Arrow lake (outside the Railway Belt.) Drainage area, 57 square miles. Logging interests and possible water-power developments. A head of 1,100 feet may be obtained in 3 miles. Two small storage lakes. On September 16, 1912, the discharge was 58 c.f.s. (Columbia drainage.)

Salmon River.—A small tributary of Fraser river from the south, in township 11, E.C.M. (Fraser drainage.)

Salmon River.—Now called Nahatlatch river.

Salmon River.—A rather important river flowing into Shuswap lake at Salmon Arm. For complete description and hydrographic data see River Station on Salmon river. (Shuswap lake-South Thompson drainage.)

Saw-mill Creek.—A small tributary of Fraser river from the west, in township 7-26-6. (Fraser drainage.)

Saw-mill Creek.—A very small tributary of Fraser river, in township 14-27-6. (Fraser drainage.)

Schedam Creek.—Now called Paul creek. (Q.V.)

Schkam Creek and Lake.—A very small tributary of Fraser river, in township 5-26-6. (Fraser drainage.)

Scotch Creek.—A tributary of Shuswap lake from the north, in township 22-11-6. Drainage area 360 square miles. (Shuswap-South Thompson drainage.)

Scotch Creek.—A small tributary of Incomappleux river from the west, 3 miles from Cambourne. (Incomappleux-Columbia drainage.)

Scottie Creek.—A tributary of Bonaparte river from the east, in township 23-25-6. Used for irrigation. For hydrographic data see River Station on Scottie creek. (Bonaparte-Thompson drainage.)

Scuttoe Creek.—A tributary of Campbell lake, in township 18-16-6. (Campbell-South Thompson drainage.)

Scuittoe Lake.—Emptying into east fork of Campbell creek, in township 18-16-6.

Scuzzy Creek.—A tributary of the Fraser river from the west, in township 10-26-6. The drainage area is 90 square miles. Small power possible. (Fraser drainage.)

Sedge Lake.—A small lake in the hills to the east of Deadman river, in township 22-21-6.

Semmihault Creek.—A tributary of Fraser river, in township 26, E.C.M. (Fraser drainage.)

Separating Lake.—A small lake in section 34, township 20-23-6.

Separation Lake.—Empties into Anderson creek, thence into Campbell creek, in township 19-17-6. (Campbell-South Thompson drainage.)

Serpentine River.—Flows into Boundary bay in township 1, W.C.M. (Fraser drainage.)

Seven Mile Creek.—Now called Inkikuh creek.

Seventeen Mile Creek.—A small tributary of Fraser river from the east, in township 9-26-6. (Fraser drainage.)

Seymour Arm.—The most northerly arm of Shuswap lake.

Seymour River.—Flows into Seymour arm of Shuswap lake from the north. (Shuswap lake-South Thompson drainage.)

Sherbrooke Creek.—A small stream flowing into Kicking Horse river from the north, in township 28-17-5, about 1 mile west of Hector, B.C. Small power possibilities. (Kicking Horse-Columbia drainage.)

Sherbrooke Lake.—An enlargement of Sherbrooke creek in section 6, township 29-17-5. Good storage.

Shumway Lake.—A lake about 2 miles long, in township 18-17-6, discharging into Campbell creek. (Campbell-South Thompson drainage.)

Shuswap Lake.—A large lake at the head of the South Thompson river. (South Thompson drainage.)

Shuswap River.—A large river rising in Mabel lake and flowing into Shuswap lake at Sicamous. For hydrographic data see River Station on Shuswap river. (Shuswap lake-South Thompson drainage.)

Sibbalds Creek.—A small tributary of Columbia river, in township 23-2-6, near Revelstoke. (Columbia drainage.)

Silver Creek.—Now called Silver Hope creek.

Silver Creek.—A tributary of Harrison lake, in township 7-29-6. (Harrison-Fraser drainage.)

Silver Creek.—Now called Silver Pitt creek.

Silver Creek.—A tributary of Salmon river, in township 19-10-6. On August 22, 1911, discharge was 3.5 c. f. s. (Salmon-Shuswap lake-South Thompson drainage.)

Silver Creek.—A tributary of Illecillewaet river from the north, in township 25-28-5. Timber and possibly mining. (Illecillewaet-Columbia drainage.)

Silverdale Creek.—A small stream flowing into Fraser river from the north, in township 17, E.C.M. (Fraser drainage.)

Silver Hope Creek.—A tributary of Fraser river from the south, in township 5-26-6, near Hope. Timber and small power. For hydrographic data see River Station on Silver-Hope creek. (Fraser drainage.)

Silver Hope Lake.—An enlargement of Silver Hope creek, in township 4-26-6.

Silver Pitt Creek.—A small stream flowing into Pitt river from the west, just at the outlet of Pitt lake. Small industrial power development is possible. The town of Coquitlam also has this stream under consideration for civic water supply. (Pitt-Fraser drainage.)

Siwash Creek.—A very small tributary of Fraser river from the east, in township 13-27-6. (Fraser drainage.)

Siwash Creek.—A very small tributary of Fraser river from the east, in township 7-26-6. (Fraser drainage.)

Siwash Creek.—A tributary of Tulameen river, in township 6-23-6.

Siwhe Creek.—A small tributary of Fraser river from the west, in township 17-27-6, above Lytton. (Fraser drainage.)

Sixmile Creek.—Now called Bolean creek.

Sixmile Creek.—A tributary of Beaver river from the west, in township 29-25-5. Timber and mining. (Beaver-Columbia drainage.)

Skackan Creek.—A tributary of Nicola river, in township 15-24-6. (Nicola-Thompson drainage.)

Skimikin Lake.—At the head-waters of Granite creek, in section 24, township 21-12-6. (Granite-Shuswap lake-South Thompson drainage.)

Skookumchuck Creek.—A very small tributary of Guichon creek, at its head-waters in township 19-22-6. (Guichon-Nicola drainage.)

Skoonka Creek.—A small tributary of Thompson river from the west, in township 16-25-6. Water diverted into Botanic lake for irrigation purposes. (Thompson drainage.)

Skuhost Creek.—A small tributary of Skuhun creek, in township 16-23-6. (Skuhun-Nicola drainage.)

Skuhun Creek.—A tributary of Nicola river from the east, in township 15-24-6; very little agricultural land up the valley. Discharge, on September 16, 1911, was 5·5 c.f.s. (Nicola-Thompson drainage.)

Skuppa Creek.—A small tributary of Fraser river from the east, in township 14-27-6. (Fraser drainage).

Skwellepil Creek.—A small tributary of Chehalis lake, in township 6-1-7. (Chehalis-Harrison-Fraser drainage.)

Skwowolt Creek.—A small tributary of Fraser river, in township 5-27-6. (Fraser drainage.)

Sleetsis Creek.—A small tributary of Thompson river from the west, in township 16-25-6. (Thompson drainage.)

Slesse Creek.—A tributary of Chilliwack river from the south, in township 1-28-6. (Chilliwack-Sumas-Fraser drainage.)

Slick Creek.—A small stream flowing into Incomappleux river, in township 25-26-5. (Incomappleux-Columbia drainage.)

Slollicum Creek (Slollicum, meaning wraith).—A small mountain stream, with beautiful wraith-like falls, flowing into Harrison lake, in township 5-28-6. (Harrison-Fraser drainage.)

Sluckamin Creek.—A small tributary of Fraser river from the west, in township 13-26-6. (Fraser drainage.)

Snohoosh Lake.—Now called Deadman lake.

Snowshoe Creek.—A small tributary of Silver creek, in township 9-29-6. (Silver-Harrison-Fraser drainage.)

Sodalite Creek.—A tributary of Ice river, in township 25-18-5. Ice-Beaverfoot-Kicking Horse-Columbia drainage.)

Soucah Creek.—A small tributary of Fraser river from the east, in township 6-26-6. (Fraser drainage.)

South Pass Creek.—A small stream flowing into Three Valley lake, in township 23-4-6. (Eagle-Shuswap lake-South Thompson drainage.)

South Thompson River.—Rises in Shuswap lake and joins the North Thompson river at Kamloops. See hydrographic data on South Thompson river. (Thompson drainage.)

Spa Creek.—A small tributary of Salmon river from the west, in township 18-10-6. (Salmon-Shuswap lake-South Thompson drainage.)

Spallumcheen Lake.—A small lake in township 17-10-6 in the Okanagan divide.

Spallumcheen River.—Now called Shuswap river. (Q.V.)

Spanish Lake.—A small lake at the head of Warren creek, in township 18-11-6. (Warren-Salmon drainage.)

Speyum Creek.—A small tributary of Fraser river from the west, in township 11-26-6. (Fraser drainage.)

Spillimacheen River.—A large tributary of Upper Columbia river from the west, 40 miles south of Golden. Timber, mining and undeveloped power. For complete description see hydrographic data on Spillimacheen river. (Upper Columbia drainage.)

Spinster Creek.—A small tributary of Gold creek, in township 31-27-5. (Gold-Columbia drainage.)

Spius Creek.—(Also called Petit creek.) An important tributary of Nicola river from the south, in township 14-23-6. Near Canford. Timber irrigation and possibly small power. For hydrographic data see River Station on Spius creek. (Nicola-Thompson drainage.)

Split Creek.—A small tributary of Blaeberry river, in township 29-21-5. (Blaeberry-Columbia drainage.)

Sproat Creek.—A tributary of Columbia river, in township 21-29-5, south of Revelstoke. (Columbia drainage.)

Spuzzum Creek.—A tributary of Fraser river from the west, in township 8-26-6. Timber and small power. (Fraser drainage.)

Squianny Creek.—A small tributary of the Thompson river from the east, in township 16-25-6. (Thompson drainage.)

Stacey Creek.—A small tributary of Upper Columbia river from the east, near section 30, township 26-21-5. (Upper Columbia drainage.)

Stadia Creek.—A tributary of Chehalis river, in township 6-1-7.

Stake Lake.—A small lake at the head of Meadow creek, in township 18-18-6. (Meadow-Guichon-Nicola drainage.)

Starvation Creek.—A tributary of Tulameen river, in township 7-22-6. (Tulameen-Similkameen, etc,. drainage.)

Statlu Creek.—Tributary of Chehalis river from the west, in township 4-30-6; Chehalis river used to be called Statlu, but this name is now given to the west fork.

On November 2, 1911, the discharge was 40 c.f.s. (Chehalis-Harrison-Fraser drainage.)

Stave Lake.—A lake some 8 miles long and from 2 to 3 miles wide at the head of Stave river. Important for logging and storage for power.

Stave River.—An important river flowing into Fraser river from the north, near Ruskin. There are two good power sites, one of which (the upper) has been developed by the Western Canada Power Co. Hydrographic investigations of Stave river have been made by the Western Canada Power Co. for a period of years. The timber interests on Stave river, also are considerable. (Fraser drainage.)

Steelhead Creek.—Local name of Cascade creek, a small tributary of Stave river.

Steelhead Creek.—A small stream flowing into Morris river, in township 4-29-6. (Morris-Harrison-Fraser drainage.)

Steep Creek.—A tributary of Beaverfoot river in township 25-19-5. (Beaverfoot-Kicking Horse-Columbia drainage.)

Stein Creek.—An important tributary of Fraser river from the west, in township 15-27-6 just above Lytton. Irrigation and undeveloped power. For hydrographic data see River Station on Stein creek. (Fraser drainage.)

Stewart Creek.—A tributary of Sumas lake from the east, in township 22, E.C.M. (Sumas-Fraser drainage.)

Stinking Lake.—A small lake emptying into Eight-mile creek, in township 21-23-6. (Eight-mile-Thompson drainage.)

Stony Creek.—A mountain stream flowing into Beaver river from the west, in township 28-25-5. (Beaver-Columbia drainage.)

Stoyoma Creek.—A small tributary of Fraser river from the east, in township 11-26-6. Small undeveloped power. (Fraser drainage.)

Stryen River.—A tributary of Stein creek, in township 15-27-6. (Stein-Fraser drainage.)

Stulkawhist Creek.—A small tributary of Fraser river from the west, in township 6-26-6. (Fraser drainage.)

Sturgeon Slough.—Draining into Pitt river, in township 40, E.C.M. (Pitt-Fraser drainage.)

Succour Creek.—A tributary of Bush river, near its mouth, in township 32-26-6. (Bush-Columbia drainage.)

Sucker Creek.—A small tributary of Coquihalla river, in township 5-26-6. (Coquihalla-Fraser drainage.)

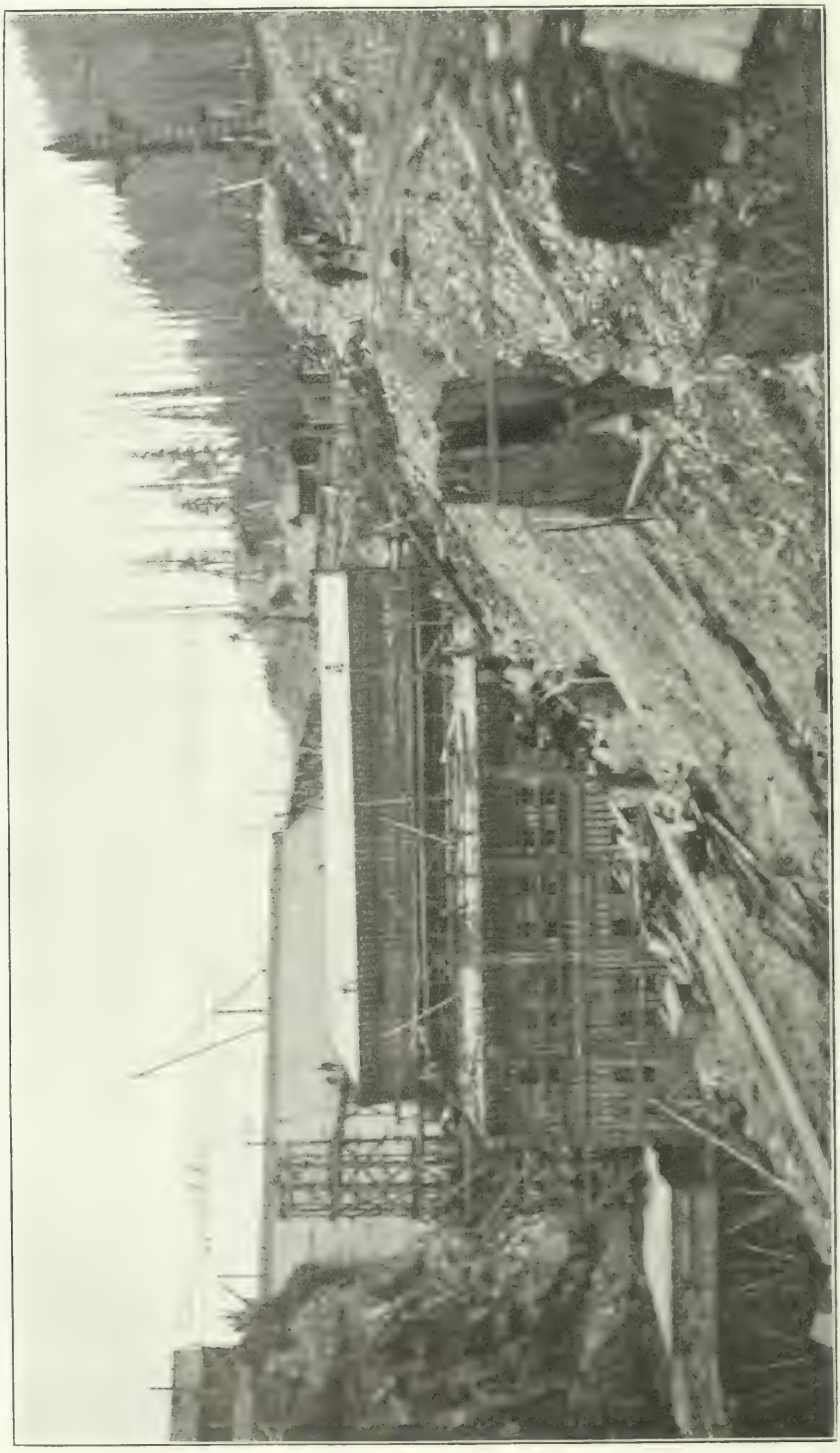
Suicide Creek.—A small tributary of Fraser river from the north, in township 20, E.C.M.

Sullivan Creek.—Small irrigation stream flowing into North Thompson river from the east, in township 22-17-6. See hydrographic data. (North Thompson drainage.)

Sumallow River.—Rises in township 3-24-6 and flows southerly into Skagit river, thence across the international border into United States.

Sumas Lake.—A lake of some 9,000 acres on the south side of Fraser river in Sumas district. The lake is tidal and flooded during the high water season of Fraser and Chilliwack rivers. The Sumas dyking project is to dyke and drain Sumas lake and the surounding country. (Sumas-Fraser drainage.)

Sumas River.—A tributary of Fraser river from the south, in township 20, E.C.M. (Fraser drainage.)



Western Canada Power Co. Stave River Dam and Power House.

Summit Creek.—A small tributary of Shuswap river from the west, in township 19-9-6. (Shuswap-South Thompson drainage.)

Summit Lake.—A lake of about 400 acres, in township 18-14-6, and used as a storage reservoir for irrigation, some of the water of Monte creek being diverted into it. The lake discharges through Essell creek, and is used in Grand Prairie. (Essell-Salmon-Shuswap lake-South Thompson drainage.)

Summit Lake.—A small lake at Eagle pass, in township 23-3-6, flowing into the Eagle river. (Eagle-Shuswap lake-South Thompson drainage.)

Summit Lake.—A small lake at 'The Great Divide,' in township 29-17-5. (Kicking Horse-Columbia drainage.)

Sunbeam Lake.—A small mountain lake (elevation 6,500 feet) draining into Spinster creek, in township 30-26-5. (Spinster-Gold-Columbia drainage.)

Surprise Creek.—A small mountain stream flowing into Beaver river from the west, in township 28-25-5. (Beaver-Columbia drainage.)

Sweltzer Creek.—Rises in Cultus lake and flows into the Chilliwack river, in township 22, E.C.M. See hydrographic data on Sweltzer creek.

Takakkaw Falls.—Flowing into the Yoho river from the east, in township 29-18-5, 12 miles north of Field. A sheer fall of 1,250 feet from Daly glacier. Important for its scenic beauty. (Yoho-Kicking Horse-Columbia drainage.)

Tallon Creek.—A tributary of Beaverfoot river, in township 25-19-5. (Beaverfoot-Kicking Horse-Columbia drainage.)

Tamihi Creek.—A tributary of Chilliwack river, in township 25, E.C.M. (Chilliwack-Sumas-Fraser drainage.)

Ten-mile Creek.—Now called Guichon creek.

Thompson River.—One of the largest and most important rivers in British Columbia, flowing into the Fraser river at Lytton. For complete description and hydrographic data see River Station on Thompson river. (Fraser drainage.)

Three-mile Creek.—An irrigation stream flowing into Kamloops lake from the south, in township 21-21-6. See miscellaneous measurements on Three-mile creek. (Thompson drainage.)

Three Valley Lake.—A small lake, being an enlargement of Eagle river, in township 23-4-6; timber interests. (Eagle-Shuswap lake-South Thompson drainage.)

Tikwalus Creek.—A small tributary of Fraser river from the west, in township 9-26-6. (Fraser drainage.)

Tobacco Creek.—A tributary of Deadman river, in township 23-22-6. (Dead-man-Thompson drainage.)

Toby Creek.—A large tributary of Upper Columbia from the west, just below lake Windermere. Timber, irrigation and power. For complete description and hydrographic data see River Station on Toby creek. (Upper Columbia drainage.)

Tokumm Creek.—A tributary of Vermilion river, in township 26-16-5, thence into the Kootenay.

Tonkawatla River.—A tributary of Columbia river from the west, in township 23-2-6, near Revelstoke, also called Tum Tum river. (Columbia drainage.)

Town Creek.—A small stream flowing into the northeast arm of Upper Arrow lake, opposite Beaton. (Columbia drainage.)

Tranquille Lake.—A small lake near the head-waters of Tranquille river, in township 23-19-6.

Tranquille River.—An irrigation stream flowing into Kamloops lake from the north, in township 20-19-6. For hydrographic data see River Station on Tranquille river. (Thompson drainage.)

Takakkaw Falls, Yoho Valley.

Trapp Lake.—A small lake near the head-waters of Campbell creek, in township 17-17-6. Storage for irrigaton. (Campbell-South Thompson drainage.)

Trinity Creek.—A small tributary of Shuswap river, from the south, in township 18-7-6. (Shuswap-South Thompson drainage.)

Trout Lake.—A small lake near the east shore of Harrison lake, in township 4-28-6. (Harrison-Fraser drainage.)

Trout Lake.—In township 17-19-6, about 20 miles south of Kamloops; also called Fish lake. (Q.V.)

Trout Lake Creek.—A small stream from Trout lake flowing into Harrison lake, in township 4-26-6. (Harrison-Fraser drainage.)

Tsileuh Creek.—A tributary of the Fraser river from the west, in township 9-26-6. (Fraser drainage.)

Tskinakin Creek.—A tributary of Adams lake from the southeast, in township 25-12-6. (Adams-Shuswap lake-South Thompson drainage.)

Tsotin Lake.—A small lake up Eight-mile creek, in township 21-23-6. (Thompson drainage.)

Tsuius Creek.—A tributary of Mabel lake from the east, in township 19-5-6. (Shuswap-South Thompson drainage.)

Tulameen River.—Rises in township 4-23-6, near the south limit of the Railway Belt, and discharges into Similkameen river outside the Railway Belt.

Tum Tum River.—Now called Tonkawatla river.

Tunkwa Lake.—Also called Big lake, in township 19-21-6, at the head of the west fork of Three-mile creek. Water is diverted from Guichon creek into Tunkwa lake, there stored and conducted down Three-mile creek for irrigation purposes. (Thompson drainage.)

Twaal Creek.—An irrigation stream flowing into Thompson river from the west, just above Spences Bridge, in township 17-25-6. See miscellaneous measurements on Twaal creek. (Thompson drainage.)

Twaal Lake.—A very small lake near the head-waters of Twaal creek, in township 18-25-6.

Twelve-mile Creek.—A small tributary of Upper Columbia river from the west, in township 26-21-5. (Upper Columbia drainage.)

Twenty-mile Creek.—A small tributary of Harrison lake, in township 7-29-6. (Harrison-Fraser drainage.)

Twenty-two Mile Creek.—Locally called Paddys creek, a small irrigation stream flowing into Upper Columbia river from the east, in township 27-20-5. (Upper Columbia drainage.)

Twenty-eight Mile Creek.—A small tributary of Upper Columbia river from the east, near the south limit of the Railway Belt. The discharge on July 15, 1912, was 0·6 c.f.s. (Upper Columbia drainage.)

Twig Creek.—A tributary of Salmon river above Grand Prairie, in township 16-14-6. (Salmon-Shuswap lake-South Thompson drainage.)

Twilight Creek.—A tributary of Six-mile creek, in township 30-26-5. (Six-mile Beaver-Columbia drainage.)

Twin Creeks.—Two small streams flowing into Illecillewaet river from the south, in township 24-29-5, about 10 miles east of Revelstoke. (Illecillewaet-Columbia drainage.)

Twin Lakes.—A storage reservoir in section 25, township 20-23-6, storing the diverted waters of Barnes creek, thence to British Columbia Horticultural Estate. Area, 80 acres. Capacity of 1,200 acre-feet.

Uztlius Creek.—A tributary of Anderson river, in township 10-25-6. (Anderson-Fraser drainage.)

Van Horne Creek.—A small mountain stream flowing into Incomappleux river, in township 25-26-5. (Incomappleux-Columbia drainage.)

Vedder River.—A small stream flowing into Sumas lake from the east, in township 23, E.C.M., and through which the whole body of Chilliwack river now flows. (Sumas-Fraser drainage.)

Venables Creek.—An irrigation stream flowing into Thompson river from the west, in township 18-24-6. See hydrographic data on River Station on Venables creek. (Thompson drainage.)

Venables Lake.—A small storage lake in Venables creek, in township 18-25-6.

Vermilion River.—A tributary of Kootenay river, rising in the Railway Belt, in township 25-16-5. (Kootenay drainage.)

Victor Lake.—A small lake in Eagle Pass, near Clanwilliam, B.C., in township 23-3-6. Timber pondage. (Eagle-Shuswap lake-South Thompson drainage.)

Viola Creek.—Flows into Coquitlam lake from the east, 2 miles from outlet of lake, in township 5-6-7. On October 26, 1912, discharge was 258 c.f.s. (Coquitlam-Fraser drainage.)

Vulcan Creek.—A small stream flowing into Pitt lake from the east, in township 5-4-7. (Pitt-Fraser drainage.)

Wahleach Creek.—Now called Jones creek, in township 4-27-6. (Q.V.)

Waitabit Creek.—A tributary of Columbia river from the north, in township 29-23-5 at Donald. (Columbia drainage.)

Walker Creek.—A small stream in township 13, E.C.M.

Wap River.—Also called Frog creek (Mabel lake.) (Q.V.)

Warmspring Creek.—A small tributary of Upper Columbia river from the east, in township 23-18-5. On July 15, 1912, the discharge was 2·0 c.f.s. (Upper Columbia drainage.)

Warren Creek.—Also called Ferris creek, an irrigation stream flowing into Salmon river in section 36, township 17-12-6. See hydrographic data on River Station on Warren creek. (Salmon-Shuswap lake-South Thompson drainage.)

Warren Creek.—A small tributary of middle fork of Spillimacheen river, in township 23-20-5. (Spillimacheen-Upper Columbia drainage.)

Washout Creek.—A tributary of Upper Columbia river from the east, in township 25-21-5. See miscellaneous measurements on Washout creek. (Upper Columbia drainage.)

Watching Creek.—A tributary of Tranquille river from the east, in township 21-19-6. (Tranquille-Thompson drainage.)

Waterfall Creek.—A small tributary of Beaver river from the west in township 27-25-5. (Beaver-Columbia drainage.)

Weaver Creek.—A tributary of Morris river, in township 4-29-6. (Harrison-Fraser drainage.)

Weaver Lake.—A small lake at the head of Weaver creek.

Welcome Lake.—A small lake in township 38, W.C.M. (Fraser drainage.)

Wentworth Lake.—A lake near the head of Jamieson creek, used by British Columbia Fruitlands Company as a storage reservoir. (Jamieson-North Thompson drainage.)

White Creek.—A small creek flowing into Salmon Arm from the north, in township 21-10-6, near Twappen. On October 6, 1911, the discharge was 1·8 c.f.s. (Salman Arm-Shuswap lake-South Thompson drainage.)

White Lake.—A lake 3 miles long at the head of White creek, in township 22-10-6.

Whitepine Creek.—A tributary of Bluewater creek, in township 30-24-5. (Bluewater-Columbia drainage.)

Whiterock Creek.—A tributary of Venables creek, in township 19-25-6. (Venables-Thompson drainage.)

Whonock Creek.—A small tributary of Fraser river from the north, in township 14, E.C.M. (Fraser drainage.)

Whonock Lake.—A small lake in section 17, township 15, E.C.M., discharging into Whonock creek.

Willowbank Creek.—A small tributary of Blaeberry river from the west, in township 29-22-5. (Blaeberry-Columbia drainage.)

Witch Creek.—A tributary of Guichon creek from the west, in township 18-21-6. For hydrographic data see River Station on Witch creek. (Guichon-Nicola-Thompson drainage.)

Wolf Lake.—A small lake in township 18-16-6, flowing into Scuittoe creek. (Campbell-South Thompson drainage.)

Woodland Creek.—A tributary of Scuittoe creek, in township 18-15-6. (Campbell-South Thompson drainage.)

Woods Creek.—A small tributary of Pukaist creek, in township 18-24-6. (Pukaist-Thompson drainage.)

Woods Creek.—A tributary of Salmon river above Grand Prairie, in township 17-14-6. (Salmon-Shuswap lake-South Thompson drainage.)

Woods Lake.—At the head of Woods creek, in township 17-14-6.

Wright Lake.—A small lake emptying into Hunakwa lake, in township 25-7-6. (Anstey Arm-Shuswap lake-South Thompson drainage.)

Yale Creek.—A tributary of Fraser river, in township 7-26-6, at Yale. Timber, municipal water supply and small power. (Fraser drainage.)

Yard Creek.—A tributary of Eagle river, 10 miles from the mouth, in township 22-7-6. (Eagle-Shuswap lake-South Thompson drainage.)

Yawnak Creek.—A small tributary of Fraser river from the west, in township 16-27-6, above Lytton. (Fraser drainage.)

Yoho River.—An important tributary of Kicking Horse river from the north, in township 28-18-5. Important for its scenic beauty, mining and small power. For complete description and hydrographic data see River Station on Yoho river.

Yolo Creek.—A small tributary of Silver Hope creek, in township 3-26-6. (Silver Hope-Fraser drainage.)

Young's Creek.—Now called Greenstone creek. (Q.V.)

Young Creek.—A tributary of Brandt creek, thence of Mesliloet river from the east, in township 6-7-7; timber and small industrial power. On October 20, 1912, the discharge was 11·4 c.f.s. (Brandt-Mesliloet drainage.)

Young Lake.—A small lake at the head of Young creek.

Zinc Creek.—A tributary of Ice river, in township 26-18-5. (Ice-Beaverfoot-Kicking Horse-Columbia drainage.)

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Ashcroft
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SHUSWAP LAKE DRAINAGE DISTRICT No. 3
SICAMOUS
SEYMOUR
COLUMBIA RIVER DRAINAGE DISTRICT No. 4
DONALD
PILLMACHEEN
LYTTON
FRASER RIVER DRAINAGE
HOPE
YALE
PORT MOODY
VANCOUVER
New Westminster
VICTORIA
WATER POWER BRANCH

DONALD SHEET

WEST OF FIFTH MERIDIAN

Sectional Map.
Six Miles to one Inch

Metering stations shown thus •

Water Power Branch, Dept. of the Interior
To accompany Report "Railway Belt Hydrographic Surveys"

tional Map.
Miles to one Inch

SPILLIMACHEEN SHEET

WEST OF FIFTH MERIDIAN

Metering stations shown thus •

GLACIER MOUNTAIN PARK

COLUMBIA RIVER DRAINAGE DISTRICT No. 4

YOHO PARK RESERVE

29 28 27 26 25 24 23 22 21 20 19 18 17 16

LIMIT OF RAILWAY BELT

BATTLE RANGE

LAKEAU

MOUNTAINS

• 425
• 423
• 428
• 418
• 419
• 417
• 407
• 420
• 421
• 422
• 404

Base Map from Sectional Maps
Surveyor General's Office

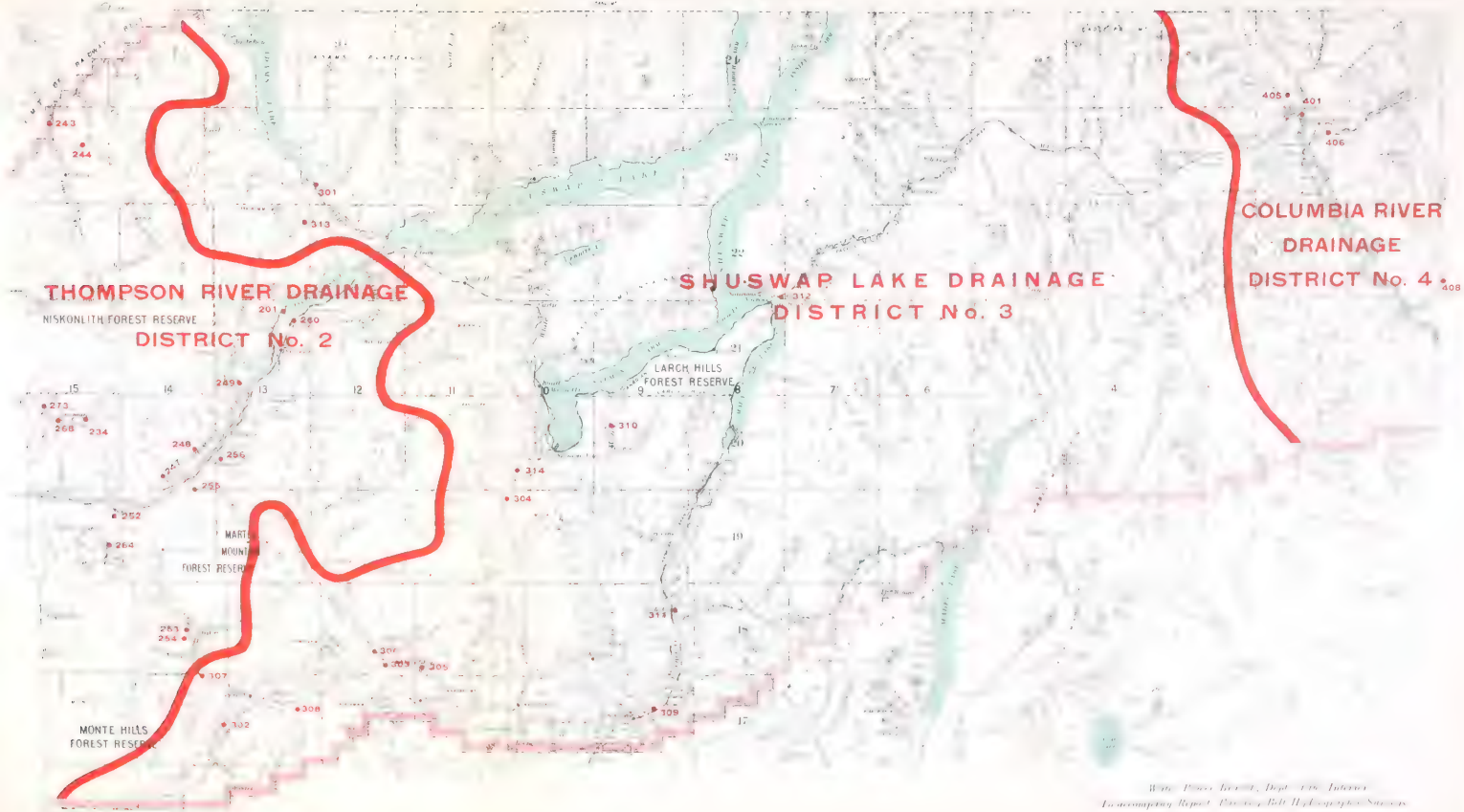
Water Power Branch, Dept. of the Interior
To accompany Report Railway Belt Hydrographic Surveys

Sectional Map
Six Miles to one Inch

SICAMOUS SHEET

WEST OF SIXTH MERIDIAN

Metering stations shown thus ●



Base Map from Sectional Maps,
Surveyor General's Office.

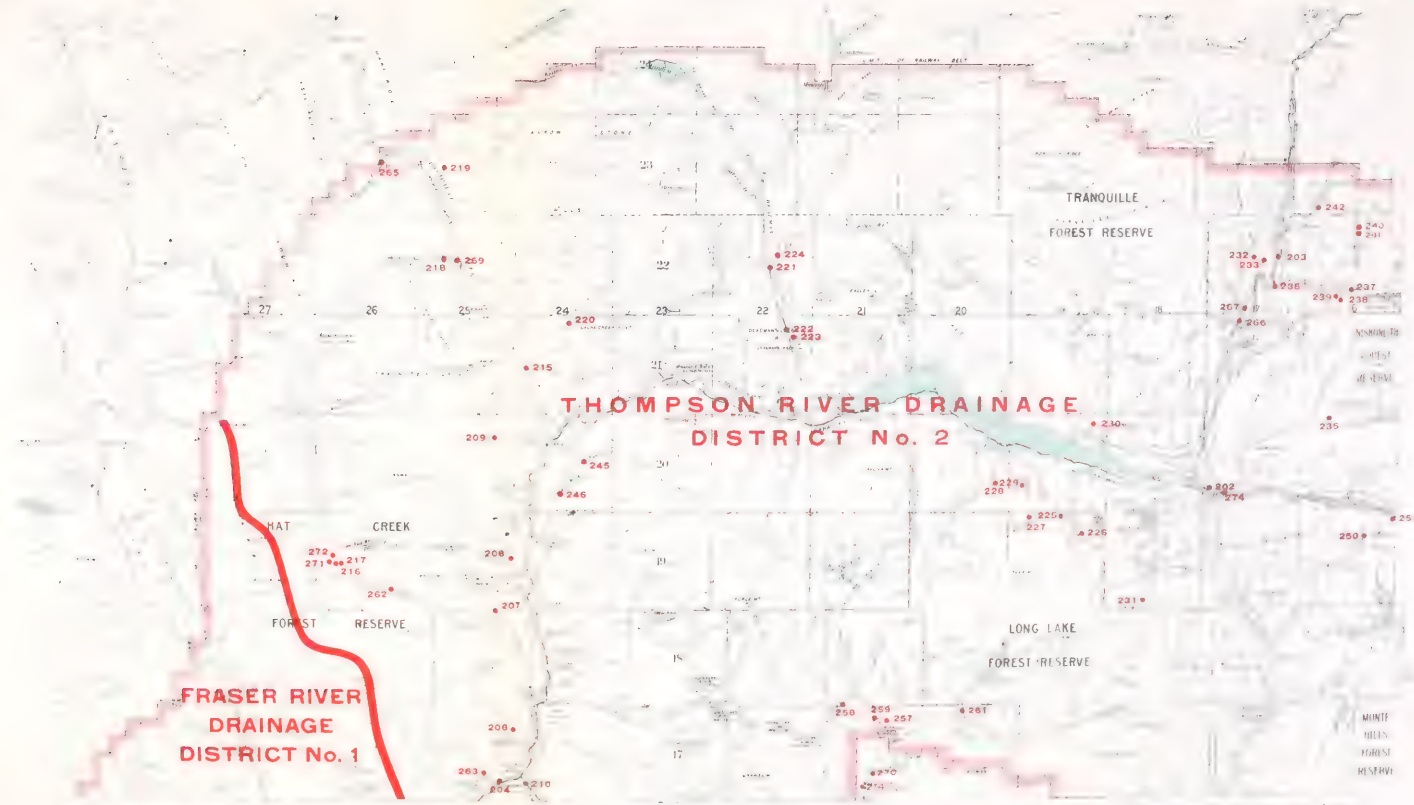
With Plans Issued by Dept. of the Interior
to accompany Report. Director, Geographical Services.

KAMLOOPS SHEET

WEST OF SIXTH MERIDIAN

Sectional Map
Six Miles to one Inch

Metering stations shown thus •



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Water Power Branch, Dept. of the Interior
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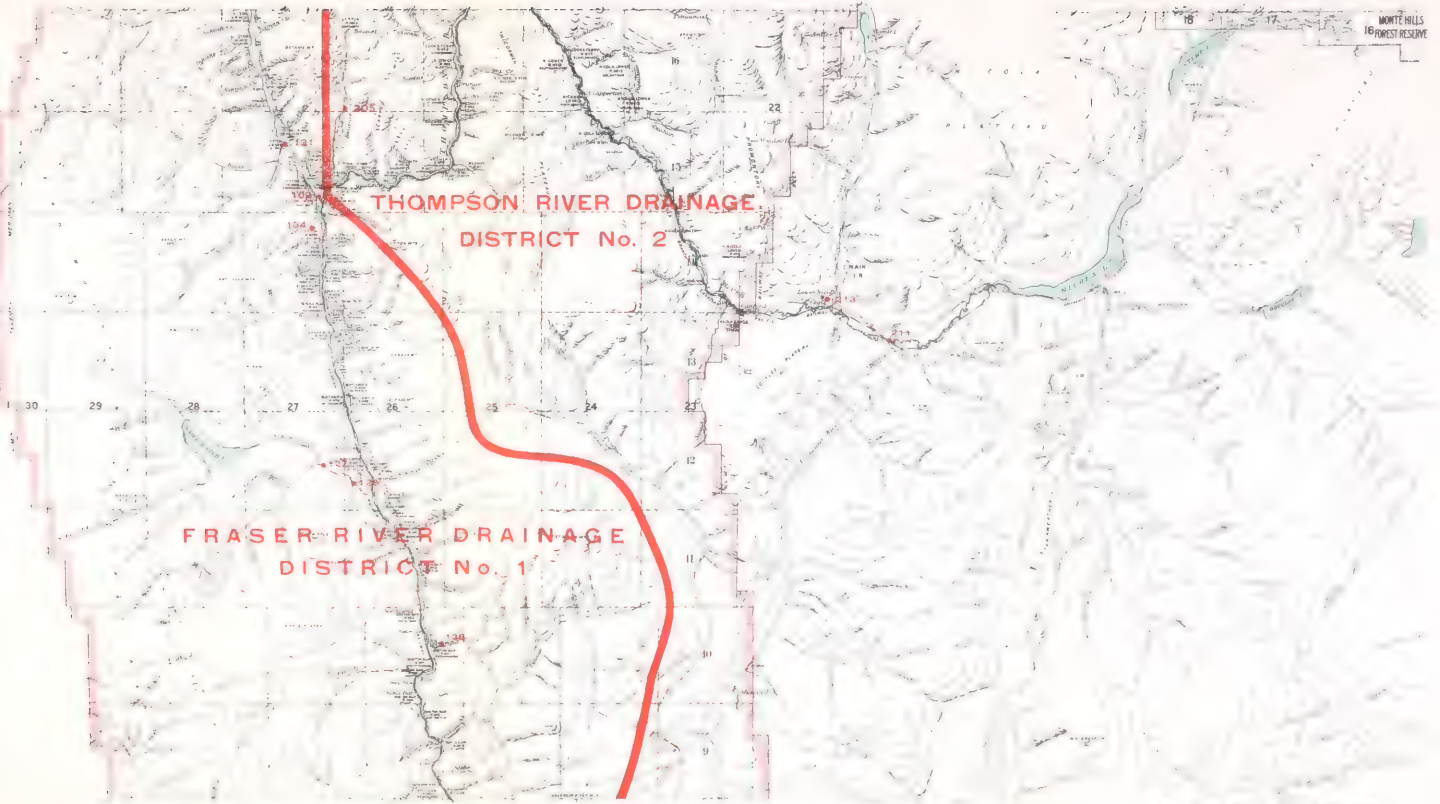
LYTTON SHEET

WEST OF SIXTH MERIDIAN

Sectional Map.
Six Miles to one Inch

Metering stations shown thus •



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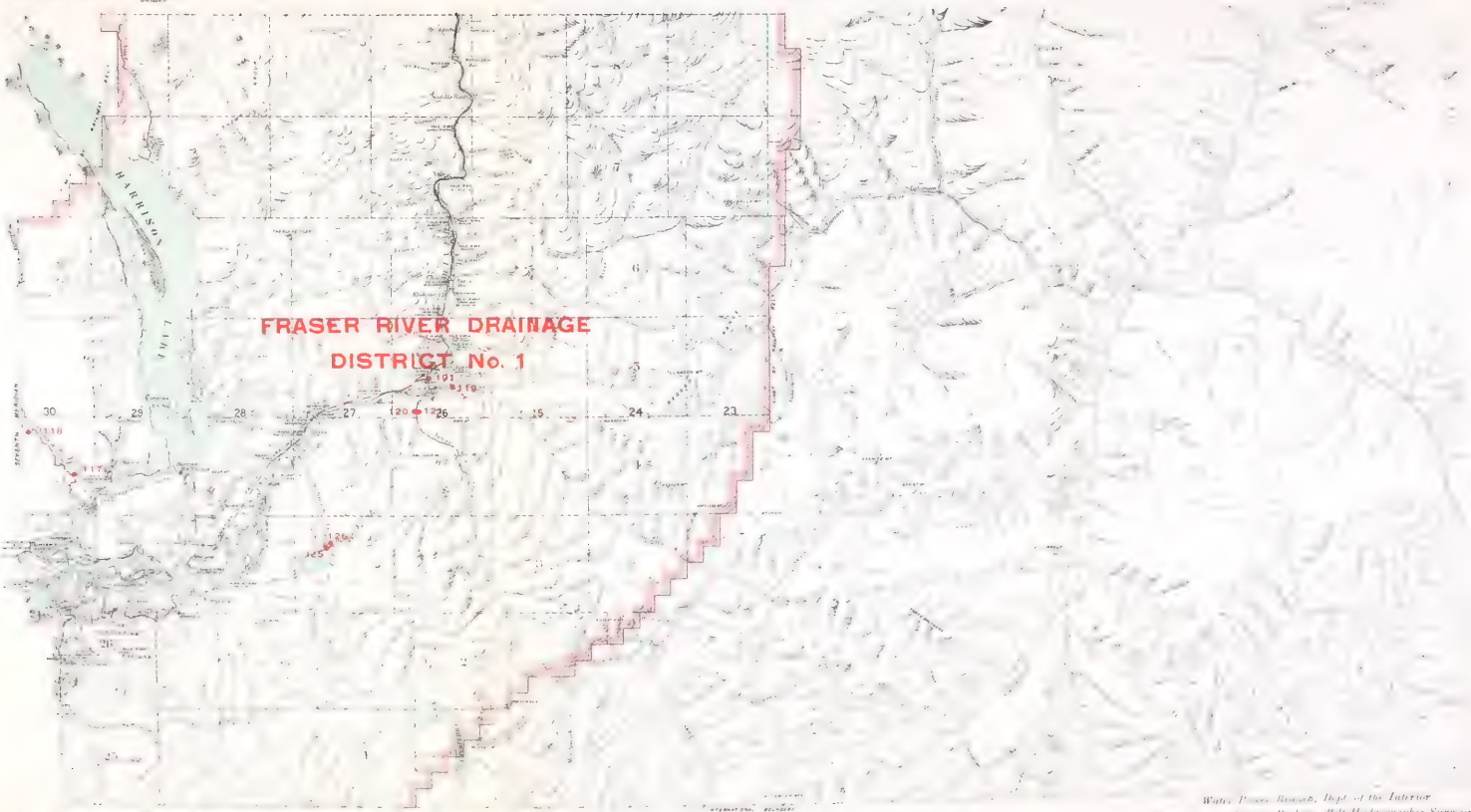
Water Power Branch, Dept. of Interior
To accompany Report Railway Belt Hydrographic Survey

YALE SHEET

WEST OF SIXTH MERIDIAN

Sectional Map.
Six Miles to one Inch.

Metering stations shown thus •



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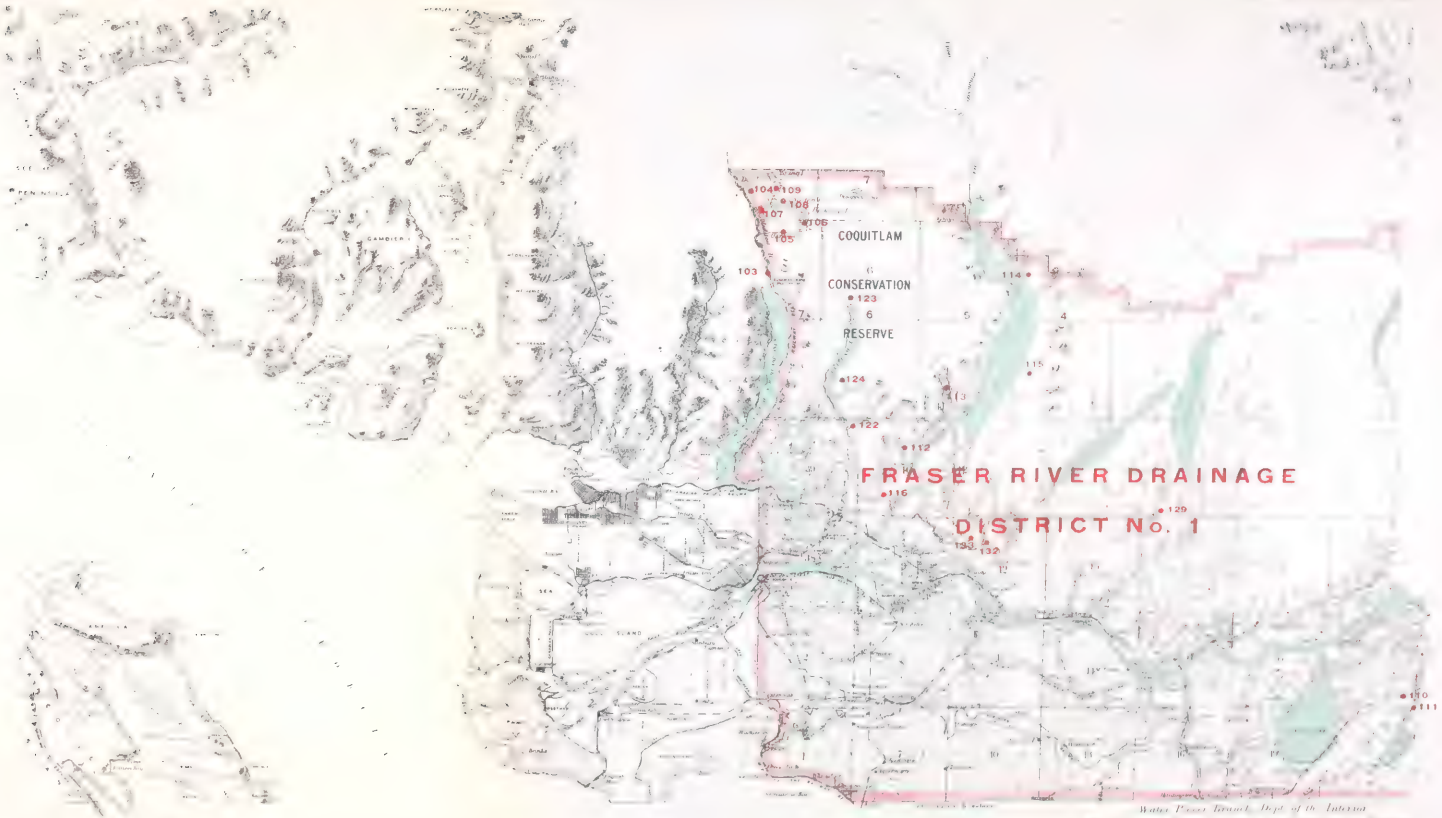
Water Power Branch, Dept. of the Interior
To accompany Report Railway Belt Hydrographic Surveys.

Sectional Map.
Six Miles to one Inch

PORT MOODY SHEET

WEST OF SEVENTH, EAST AND WEST OF COAST MERIDIANS

Metering stations shown thus ●



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To accompany Report Western Belt Hydrographic Surveys